ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

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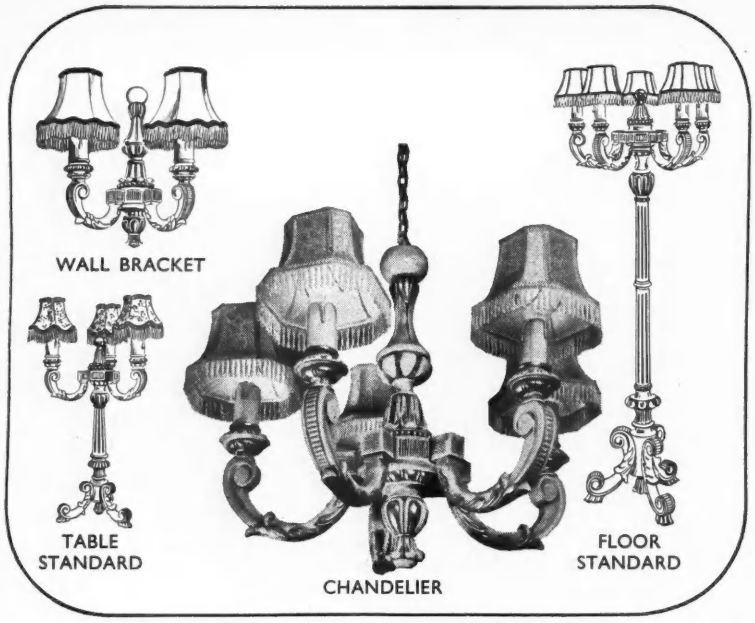

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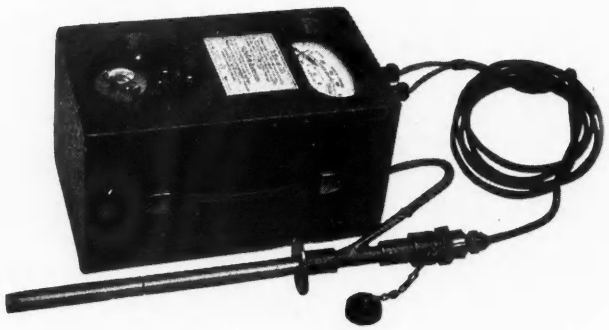

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ELECTRICAL REVIEW

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Dollar Business

RECENT events in connection with contracts for plant for the great hydro-electric schemes of the North Western United States have raised a number of interesting points. It has been our Government's policy to urge British manufacturers to go all out for American business to bring in the dollars so badly needed for the redressing of the adverse balance of payments. Many firms have obeyed the injunction and at great expenditure of energy and money have had some success. In fact it is reported that dollar business last year reached a record height. A great deal of the trade has naturally been in special products of which there is no exact American counterpart, but success has also been achieved in competitive lines, including electrical plant. It says a great deal for some of the leading British electrical manufacturers that they have secured contracts for their equipment in the country which has the largest and most competent electrical industry in the world.

The United States Government has been most anxious to encourage British imports but naturally its views are not shared by those whose interests are affected. The value of American orders obtained by British electrical manufacturers has been a minute fraction of the total home business of the American concerns but still the latter are not pleased to lose the work. This is understandable, of course, but their disappointment has to be judged in the light of the wider, international, position. It is in America's real interest that Great Britain should become independent of assistance and she can only achieve independence by selling her goods abroad. It was recently complained by one American electrical manufacturer that by allowing a contract to go to Great Britain the United States Government was losing thousands of dollars which it would have taken in taxation from an American concern. But large numbers of the American public think that too much of the money contributed by them to their Treasury goes in foreign aid. The electrical company's objection was made soon after President Eisenhower's " State of the Union " message in which he welcomed the possibility of reducing foreign economic assistance and referred to " the creation of a healthier and freer system of trade and payments within the free world—a system in which our allies can earn their own way and our own economy can continue to flourish." We are entitled to believe that the President is the authentic voice of the United States and that his ideas are those which his country will adopt as its policy. The problem is a difficult one for those immediately concerned but we hope that they will take an enlightened view.

ELECTRICITY AND TEXTILES

In the paper " Electricity in the Wool Textile Industry " which they recently presented to the Institution of Electrical Engineers, reported elsewhere in this issue, Messrs. A. J. Francis and T. H. Carr showed that the wool textile industry was, in 1951, the fourth largest manufacturing exporting industry in Great Britain. But they also concluded that: " If the industry is to survive the problems that lie ahead, it must increase its output per operative." We were consequently a little disappointed that the authors did not stress the fact that up-to-date materials handling should take first place in the list of possible contributions to increased productivity. In saying this we have in mind particularly the pneumatic system of passing fibre material from machine to machine or section to section in the raw materials preparation processes such as the scheme employed at the Catrine, Ayrshire, cotton works of Jas. Finlay & Co., Ltd. (*vide Electrical Review*, 30th March, 1951). The system is so obviously suited to the handling of the type of material in question—textile fibres—and it keeps the rate of feeding to the forward section abreast of the rate of delivery from the last section, thus reducing idle running of plant sections. Further, the system is essentially an electrically operated one amenable particularly to automatic and especially electronic control.

HYDRO AND THERMAL POWER STATIONS

Wide variations in weather from season to season and from place to place have emphasized the value in many countries of thermal power stations for smoothing out irregularities in the output of hydro-electric stations. An illustration of this is furnished by the useful function served by the gas turbines at Beznau power station (Switzerland), operating experience with which was described by Mr. E. A. Kerez to the Diesel Engine Users' Association in a paper reported in this issue. After unusually dry summers the water in the lakes used for storage may not be at a high enough level to last through the winter. Also after a long and cold winter water may run short in the following spring owing to delay in the melting of glaciers feeding the reservoirs, unless the margin of storage capacity is expensively large. The installation of a simple type of gas turbine, even if rarely operated, may prove the most economical way of insuring against curtailment of supplies.

METER *v.* CONSUMER

In a case at Hastings County Court last week the Judge preferred the word of the defendant, from whom the South Eastern Electricity Board claimed an amount for electricity consumed, to the registration of her meter. As a result the Board accepted about half of the sum for which it sued, which in our view was an unfortunate decision. The meter may have erred; it successfully passed a test just after the close of the period in question but was found to be " slightly in error " some time afterwards. We are not suggesting that it was so in this instance, but we are familiar with the forgetfulness of consumers of circumstances which may have resulted in increased electricity consumption in a particular quarter. The illness of a relative may be remembered but the fact that a bedroom fire was in use for a week or more as a consequence may be entirely overlooked. Extra use of an immersion heater when the stock of boiler fuel runs out may also be forgotten and so forth. Meters may not be infallible but the Judge seemed to imply that any conflict between the evidence of a meter and that of a consumer should be decided in the latter's favour. If this is really so it institutes a very awkward precedent.

PRICES IN 1953

During last year the Board of Trade indices of wholesale prices showed a general fall as compared with 1952. Despite an upturn at the end of the year the index for materials used in the electrical machinery industry averaged 155·2 (30th June, 1949 = 100) against 165·4 for the preceding year. There was also an appreciable decline in mechanical engineering materials. Iron and steel (and, of course, coal) acted contrarily to the general trend, the annual average in each case being above the 1952 figure. For synthetic resins and plastic materials the fall was substantial from 131·3 to 125·0. Probably the most drastic downward move occurred in the case of rubber (No. 1 R.S.S. spot) which plunged from 282·8 to 199·1. As a whole the domestic electrical appliance index is said to have dropped from 115·5 to 112·9. Only vacuum cleaner prices showed a rise—a small one. In the case of cookers the annual average was 116·6 against the 1952 figure of 121·4. Refrigerators went down from 107·1 to 101·6 and washing machines from 112·2 to 108·7.

ELECTRICITY GENERATION FIGURES

Two factors which influenced electricity consumption last year—in opposite directions—were the Coronation celebrations in the summer and the unusually mild weather in the closing months of the year (contrasting with an early and prolonged period of cold weather in the winter of 1952–53). Thus the main advance in electricity output occurred in the spring and summer months, reaching 12·1 per cent in June, while in the last three months of the year the rate of expansion declined and in December was only 0·1 per cent. For the year as a whole the total amount of electricity generated by the British Electricity Authority and the North of Scotland Hydro-Electric Board was 65,512 million kWh compared with 61,989 million kWh in 1952, an increase of 5·7 per cent. Water power stations produced 1,283 million kWh, 1·2 per cent more than in the previous year. As a result of improved thermal efficiency in the steam stations the additional fuel consumption was again lower than the rise in output. Apart from a comparatively small quantity of oil fuel, the total tonnage consumed (coal, coke and breeze) was 36,443,000, an increase of about 3 per cent. Further details of the year's figures are given on page 167.

Automatic Position Control

The Application of Thyratrons

By

JOHN C. WEST, Ph.D., A.M.I.E.E.*

and

D. K. PARTINGTON, M.Sc.†

STATIC equipment has many advantages over rotating machinery and in variable speed drives gas-filled grid-controlled valves have reached a position where they are competing favourably with rotary amplifiers for the control of motors up to 600 h.p.[1, 2] In remote position control servomechanisms thyratrons have an additional advantage in the virtual absence of time constants[3, 4, 5] when supplying the high currents necessary for the control of large motors.

Thyratrons have not been used in such systems, however, because of the difficulties encountered in obtaining smooth control of reversible current. This results in a more complex system than a variable speed drive, but in position control servomechanisms, where speed of response is important, the use of thyratrons is advantageous despite the difficulties in producing a simple system.

Control of the thyratron itself is done by applying voltages to its grid, the error signal being amplified electronically with negligible time constants and used to vary the phase of a sine wave or a train of pulses which causes the thyratron to strike at varying points in the cycle. Unless the control circuit introduces large time constants, a system using thyratrons will have a faster response time than if hard valves were used, and, for the control of large motors where a rotary amplifier would have to be used, the gas-filled valve produces a much faster system and removes the necessity for additional rotating machinery. Thyratrons do suffer, however, from a time delay owing to the current being controlled by the variations of the firing angle of the thyratron. Hence a change in the input signal may vary the ignition angle simultaneously but the thyratron is unable to alter the output current until the next cycle. By using several phases, this time delay is reduced to $\frac{1}{pf}$ sec, where p is the number of phases used and f the supply frequency in c/s. The frequency may be increased to a maximum of 500 c/s, when the de-ionization time of the thyratron is equal to the time for half a cycle of the supply.[6] Without the system becoming excessively complicated and expensive, the largest number of phases is probably six. The time delay is then negligible compared to the equivalent time constant of the motor and load inertia.

Rating Variation

The current which thyratrons supply is pulsating, so that normally the motor must be derated to dissipate the increased heating.[7] In the proposed position control servomechanism no current is flowing through the armature when the system is at rest, so that there is no necessity for derating unless the operation of the servomechanism is of such a nature that maximum current is used over a large percentage of the operating period. Greater current can be supplied than the machine rating would normally permit if occasional operation only is required and, under these circumstances, the response may be improved.

Gas-filled valves have greater efficiency than hard valves and the ability to control large currents permits motors of any size to be controlled by armature current variation, without the introduction of the large time constants involved in the use of rotary amplifiers. No bulky d.c. power supply is necessary, the power being taken direct from the mains supply, and no rotating machinery is required. Many speed control systems using thyratrons are commercially available but the peculiar characteristics of gas-filled grid-controlled valves make the building of a position control servomechanism a more difficult problem. For a position control servomechanism, continuous control of the current is essential as the control signal passes through zero and reverses in sign, in order to obtain stability and final accuracy in high performance systems. Thyratrons are capable of passing current in one direction only and, in variable speed drives, reversal of the motor is accomplished by the use of contactors or, alternatively, by connecting two separate rectifier systems in reverse parallel.[8] As the ignition angle tends to 180 deg, a thyratron becomes increasingly erratic in behaviour so that neither of the above systems would be suitable for a position control servomechanism. It is necessary, therefore, to use a control system in which two separate rectifier systems each pass approximately half the maximum current required to control the motor, when the control signal is zero, but resulting in zero current flowing through the motor.

Split Field and Rectifiers

It would be possible to control the motor by utilizing a split field construction and feeding each winding by a separate rectifier, as for a hard valve amplifier. In this way, each rectifier could be passing half its maximum current when the error is zero, producing no effective field in the motor. This would introduce an undesirable field build-up time constant. In a similar manner, each rectifier could feed a separate armature, the armatures being mechanically coupled together so that equal currents produce equal and opposite torques and there is no resultant rotation of the motor. This would be a cumbersome and uneconomic system as each armature would have to be derated to allow for the increased heating[7] due to the pulsating current. An alternative system would be to supply a single armature with equal and opposite pulses of current in successive half-cycles of the supply voltage, so that zero error would result in an alternating current. This would lead to excessive heating of the armature and the motor would tend to vibrate at a frequency double

* Electrical Engineering Laboratories, The University of Manchester.
† I.C.I., Ltd., Billingham.

that of the supply. This effect is reduced in the system shown in Fig. 1 in which four thyratrons are used, each pair being connected in the usual bi-phase connection. Resistors are placed in the two leads to the armature to limit the peak thyratron current.

The operation of the circuit may be understood by reference to Figs. 2 and 3. In Fig. 2 the ignition angle of all four thyratrons is the same at, say, 90 deg when the error signal is zero. In the first half-cycle the anode of thyratron B is positive whilst its cathode remains at earth potential and the anode of thyratron D is at earth, whilst its cathode goes negative. The simultaneous ignition of these two thyratrons causes current to flow round the closed circuit presented by the two discharge paths but no current flows through the motor armature. As soon as the cathodes and anodes of thyratrons B and D reach approximately the same potential the valves are extinguished and remain in this condition for the next half-cycle. A similar action occurs in the next half-cycle with thyratrons A and C. In Fig. 3 thyratrons B and C have a smaller ignition angle, α_1, than thyratrons A and D with an ignition angle of α_2. For the first half-cycle, thyratron B strikes at α_1 and passes current through the limiting resistor and the armature of the motor. At α_2, thyratron D is ignited and the current ceases to flow through the armature. Neglecting any inductance in the circuit and the back e.m.f. due to rotation of the motor, current flows through the armature in a pulse lasting from α_1 to α_2. A similar pulse of current is passed through the armature in the next half-cycle by thyratrons A and C. Unavoidably, the armature current must be pulsating. The use of an inductance in series with the armature is undesirable as it would introduce an unwanted time constant.

Effect of Back E.M.F. of the Motor

The small inductance of the circuit will be neglected and the voltage drop across the thyratron after ignition will be assumed to be negligible compared to the voltage of the supply. This enables a simple equivalent circuit to be derived, as shown in Fig. 4, in which the first half-cycle is being considered. V_B and V_D are the instantaneous voltages at either end of the centre-tapped transformer and so V_B is the anode voltage of thyratron B and V_D is the

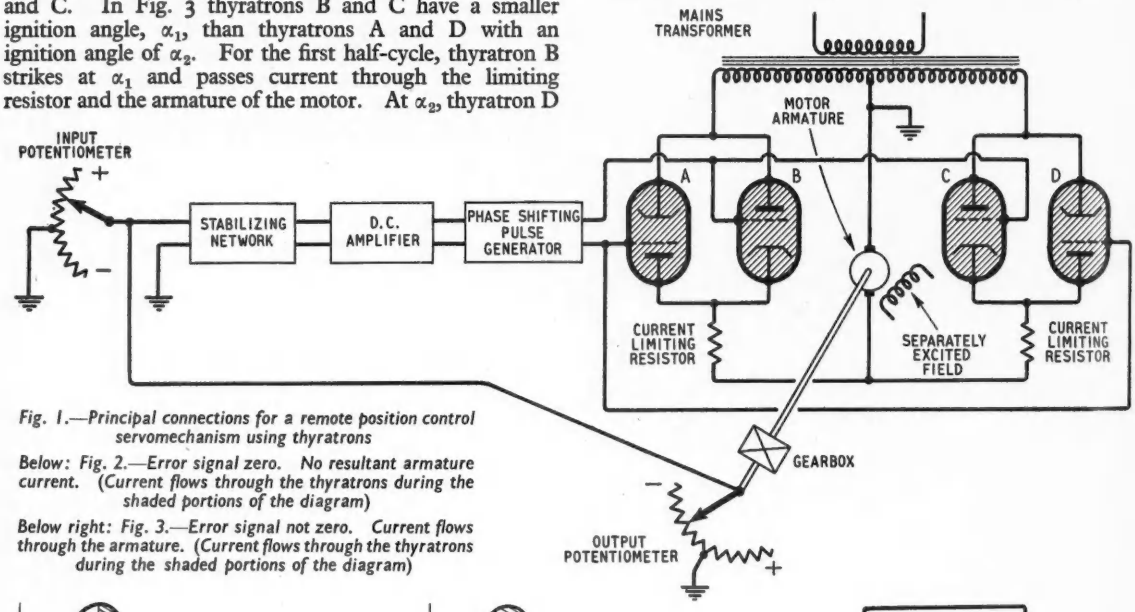


Fig. 1.—Principal connections for a remote position control servomechanism using thyratrons

Below: Fig. 2.—Error signal zero. No resultant armature current. (Current flows through the thyratrons during the shaded portions of the diagram)

Below right: Fig. 3.—Error signal not zero. Current flows through the armature. (Current flows through the thyratrons during the shaded portions of the diagram)

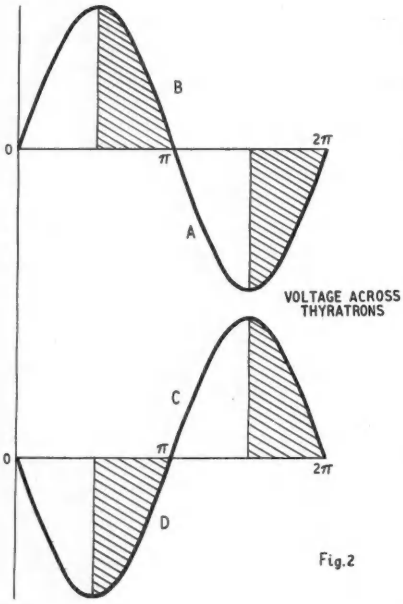


Fig. 2

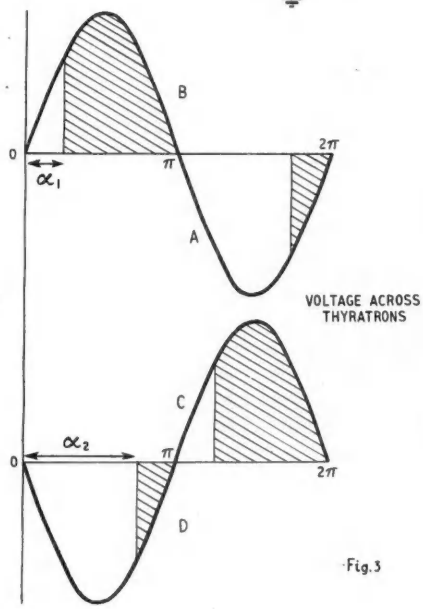
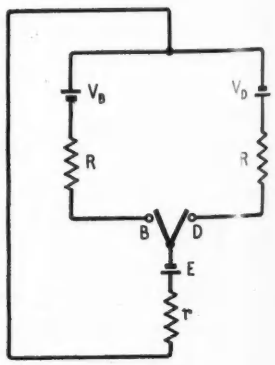


Fig. 3



Above: Fig. 4.—Equivalent circuit for thyratrons B and D during the first half-cycle

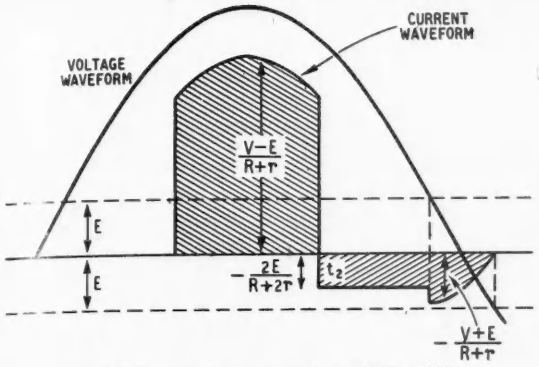


Fig. 5.—Armature current during half-cycle

cathode voltage of thyratron D. Due to rotation of the motor a back e.m.f., E, is produced which opposes that of the first ignited thyratron, which is in this case thyratron B. The two resistors R limit the peak thyratron current; the resistance of the armature is represented by r. The ignition of a thyratron is simulated by the closing of a switch, switch B being closed at time t_1 and switch D at time t_2, corresponding to ignition angles α_1 and α_2.

At time t_1, switch B closes and current flows through r, the actual value of the current being reduced by the back e.m.f. to $(V_B - E)/(R + r)$. If the ignition angle of thyratron D is tending to 180 deg, current will cease to flow before the end of the half-cycle because of the back e.m.f., and so the maximum current is limited by the back e.m.f. This results in a definite limit to the velocity of the motor. If α_2 is not tending to 180 deg, at time t_2 switch D closes and the back e.m.f. causes a reverse current to flow through the armature until thyratron D is extinguished slightly after the end of the half-cycle. The reverse current which flows may be calculated using Kirchhoff's Laws and equals $2E/(R + 2r)$ whilst thyratron B is still ignited, and $(E + V_D)/(R + r)$ whilst thyratron B is extinguished. The resulting current waveform in a half-cycle is shown in Fig. 5.

For satisfactory operation of the servomechanism it is necessary for the supply voltage to be very much larger than the back e.m.f. of the motor. If this is the case, the back e.m.f., which is proportional to the speed of rotation of the motor, has the effect of feeding back a signal tending to stabilize the system. It does prevent, however, the use of the full output of the thyratrons, as a pulse at a small ignition angle, when V is less than E, will fail to ignite the thyratron.

Method of Control

The cathodes of thyratrons A and D are alternating in potential with the supply voltage, and it is necessary for the grids of these thyratrons to be held more negative than their cathodes until the instant at which ignition should occur. No system of varying a d.c. bias to alter the ignition angle would be suitable for the control of these thyratrons and so control was accomplished by pulsing the grids at the required instant, i.e., "hard control." The phase of the pulses must be controlled by a d.c. signal from a voltage amplifier and two trains of pulses are required, shifting in opposite phase when an error signal is received. A circuit for producing such a train of pulses has been described already[9] and four such circuits were used to control the four thyratrons in the position control servomechanism.

Production of pulses by the saturation of iron-cored transformers would introduce time constants, and so the pulse forming circuit should be one in which electronic

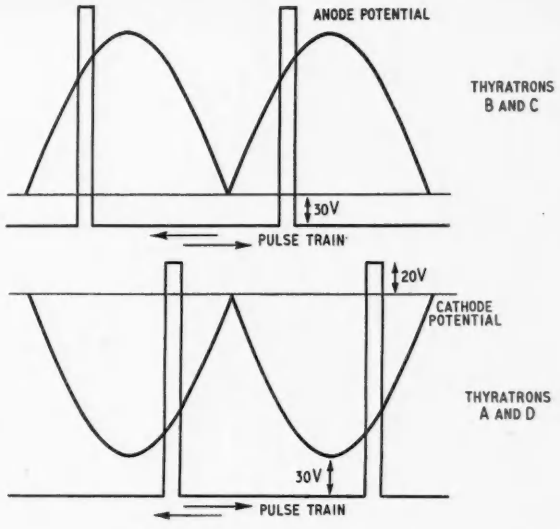


Fig. 6.—Method of thyratron control

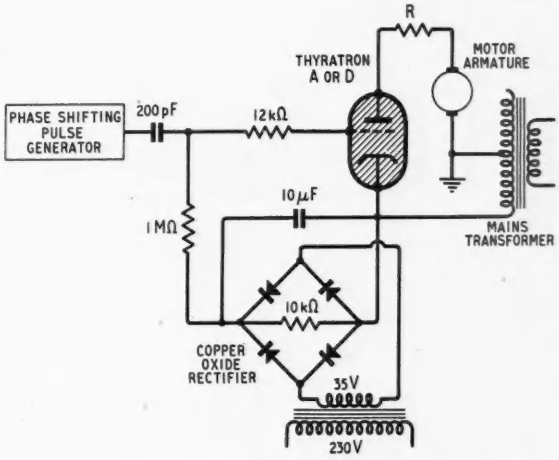


Fig. 7.—Automatic biasing circuit for thyratrons A and D

devices take the largest share in producing a train of pulses with variable phase shift.

The grids may be held at a potential more negative than the peak voltage across the thyratrons and pulses applied which exceed this peak voltage by more than 20 V. The operation of this system is shown in Fig. 6 and was used for the experimental servomechanism. It suffers from the disadvantage that a negative line is required which greatly exceeds the peak voltage supplied to the thyratrons and this results in the pulses being of excessively large amplitude.

Alternatively, this system may be used only for the thyratrons of which the cathodes remain at constant potential, holding the grids at minus 30 V relative to the cathodes until triggered by 100 V pulses. Thyratrons A and D, whose cathodes are alternating in potential, may be controlled by the circuit shown in Fig. 7. The grids are automatically biased to minus 30 V relative to the cathodes by the use of metal rectifiers fed by separate transformers, and the pulses are applied through RC couplings, whereby the d.c. levels become unimportant. This method can control large thyratrons supplied by the

full mains voltage and permits higher powers to be supplied to the motor.

Stabilizing the Servomechanism

Unless the control circuit introduces large time constants, the main time constant is that of the motor and load inertia so that the system is inherently stable due to the back e.m.f. of the motor. A satisfactory response may be obtained, therefore, with little difficulty. A signal proportional to the derivative of the output position may be obtained from a tacho-generator driven by the motor and used to give a satisfactory response. It is undesirable to use a tacho-generator housed in the same casing as the motor, since it is magnetically coupled with the armature current of the motor and, as this is pulsating, extraneous signals are produced in the tacho-generator. Having passed through the local feedback loop, these signals are amplified and cause the thyratron output to vary, leading to vibration of the motor. However, if the magnetic coupling is reduced to a minimum, by housing the tacho-generator separately and driving it by a non-magnetic shaft, the system would be satisfactory.

Alternatively, the required amount of damping may be obtained by incorporating a stabilizing network in the servo loop, so that the derivative of the error signal is fed into the amplifier, together with the error signal.

The response of the experimental servomechanism was found to be greatly improved by feeding the armature by means of thyratrons, instead of controlling the field by a hard valve amplifier, or the armature current by a rotary machine. The pulsating nature of the current had some effect on the torque characteristic of the motor but this could be reduced by increasing the number of phases. There was a slight vibration of the motor in the zero error position due to the pulse trains not being exactly identical, but this is not a disadvantage as the heating effect is small and the application of short pulses divided by static periods tends to remove the effects of friction.[10] Since the armature current is zero when there is no error signal, it is not necessary to derate the motor in order to prevent overheating, and greater currents than the motor rating may be passed through the armature if operation of the servomechanism is intermittent. This will give improved characteristics but would cause overheating and motor failure if used with a position control device incorporating a mechanism compensating for external loads. The back e.m.f. from the motor has a stabilizing influence on the servomechanism and serves to limit the maximum velocity of the motor.

Although the experimental servomechanism had a control current of only 4 A, there is no limitation to the size of the motor which could be controlled by this system.

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STUDIES IN INTERIOR LIGHTING

Apparent Brightness, Colour and Luminance

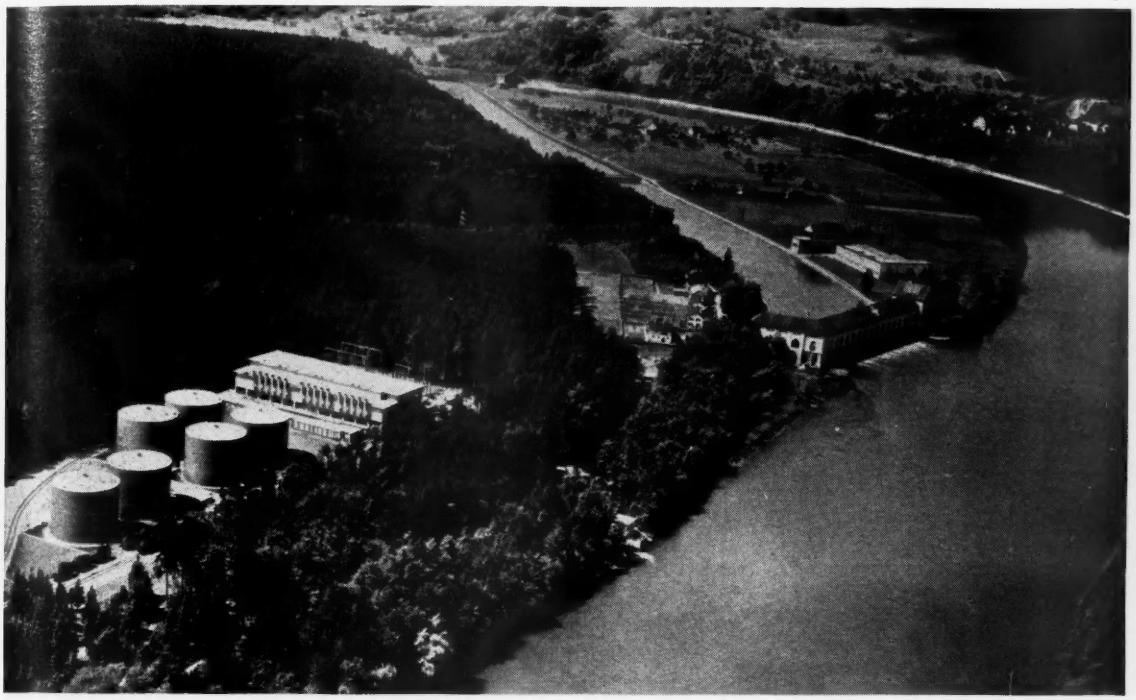
IN a paper which was presented at a meeting of the Illuminating Engineering Society held in London on 12th January, Mr. J. M. Waldram (General Electric Co., Ltd.) referred the mechanism of interior lighting to three basic parameters: the light released; the geometry; and the reflection properties of surfaces. These, he said, interacted in several stages to form a "gross pattern of luminance and chromaticity." Thereafter the process could be divided into two branches.

The gross pattern provided the adaptation level which enabled the eyes to interpret apparent brightness and colour, from which was derived colour harmony, adequacy, emphasis and comfort. Along the second branch the gross luminance pattern (which included the light sources) produced at any point a "spatial distribution of incident light." From this and other factors was derived, for any solid object, a structure pattern (composed of modelling and shadow components) which, modified by the texture pattern, formed the detailed pattern of luminance and chromaticity. This could be interpreted according to the adaptation level as a detailed pattern of apparent brightness and colour responsible for revealing form and texture. Values of luminance were often anomalous as judged by visual impressions. A tentative interpretation, however, of a scale of apparent brightness, first derived by Hopkinson, took into account the effects of adaptation and resulted in reasonably consistent numbers which linked together experiences in different situations, ranging from full outdoor daylight to street lighting. By this means apparent brightness could be translated into luminance and vice versa, enabling an architect to express his intentions.

A simple new approach to interior lighting (which had been proved to work well) was to start from the opposite direction to the usual one, i.e., to derive the installation from apparent brightness, thus avoiding inter-reflection theory. There was at present no numerical basis for "emphasis," which depended upon many factors other than apparent brightness, such as modelling, shadow contrast and colour difference. The purpose of the designer involved a harmonious combination of architecture, decoration, furnishing and lighting, and this called for a clear statement from the architect as to the effects he wished to achieve.

Gas Turbine Operation

Results Obtained at the Beznau Power Station in Switzerland



Aerial view of the Beznau gas turbine power station on the River Aare, Switzerland ; the hydro-electric station is on the right

AN account of operating experience with gas turbines was given yesterday to the Diesel Engine Users' Association by Mr. E. A. Kerez (Brown Boveri) who made particular reference to the 40 MW Beznau power station, the largest of its kind yet built. In Switzerland, he stated, 99 per cent of the consumption of 13,250 million kWh during the hydrographic year 1951–52 (1st October to 30th September) was generated by just over 3,000 MW of water power plant.

The North Eastern Swiss Power Supply Co. (N.O.K.), which supplied one sixth of the electricity consumed in that country, now owned 63 MW in thermal plant (60 MW of gas turbines and 3 MW of diesels) out of the Swiss aggregate of 144·6 MW (33·3 MW of steam, 64 MW of gas turbines and 47·3 MW of diesels). After the war N.O.K. needed 40 MW for running 1,000 to 3,000 hours each winter. It was stipulated that the new plant should generate at costs not exceeding those of hydro-electric storage plants, and should be quick starting and easy to operate and maintain. In June, 1946, the power company decided to install a 13 MW open-cycle gas turbine in a new power station at Beznau for commissioning by December, 1946, which would be followed by a 27 MW unit to be in service in January, 1949.

At the time of the order no experience was available of the operation of relatively large gas turbines designed for working temperatures of over 1,100 deg F for extended periods. The first unit serving a public electricity supply station, the 4 MW set installed by the city of Neuchatel in 1939, intended for emergency duty only, was of simple design and modest thermal efficiency. The designs of a 10 MW set being constructed for Lima (Peru) were adopted and under the winter climatic conditions at Beznau, when the mean air and cooling water temperature was 41 deg F, an output of 13 MW was obtainable.

Heavy residual oil was used as fuel and some difficulties were experienced in the early stages. With an inlet temperature of 1,112 deg F, the face of the high-pressure rotor on that side was cooled by air at 610 deg, the highest temperature (985 deg) occurring not at the first row of blading but in front of the second and third. After 300 running hours three blades broke in the third stage owing to intercrystalline cracks originating at the notch at the blade foot. This was strengthened, the original construction which followed normal steam turbine practice having thus proved to be insufficiently robust. Vibration of the rotor of the low-pressure turbine of the 13 MW set after 2,400 hours was found to be due to a crack in the bottom of the blade slot, again in the third row, as a result of notch effect. This trouble was removed by changes of construction and of the alloy used.

At the end of the winter 1948–1949 the medium- and high-pressure compressors were fouled by a type of deposit not hitherto encountered in axial blowers. The cause was traced to a wind eddy between the building and the fuel tanks when a wind from the west passed over the surrounding forest to the exhaust stack on the far side of the

building. Exhaust gas was forced down to the inlet ducts of the low-pressure compressors, which, however, were little affected. The explanation of the hard deposit was the presence of sulphur (2 per cent) in the fuel and hence of SO_2 and SO_3 in the exhaust gas. In the intercoolers the dew point was exceeded with air of high humidity, the resulting condensate forming sulphurous acids which attacked the copper of the cooler tubes to give water-soluble copper sulphates. These were carried with soot and occasionally cement dust into the succeeding compressors. During compression the water evaporated and the material it carried was deposited on the blading to form a hard layer, which could be removed only by mechanical means. No further trouble from this source has been experienced since the building of a device into the coolers to separate the condensate before the intake to the compressor.

Cleaning Requirements

Fire due to soot impregnated with fuel caused considerable damage to three out of the ten heat exchangers of the 27 MW set. Soot blowers were installed using air from the high-pressure compressor at 100 lb/sq in gauge and operated once every 36 hours during continuous running; for intermittent working the blowers were operated before shutting down the set.

Cleaning of the turbine was necessary after 300 to 400 hours full load running to remove slag from the blades, this being done by building spray nozzles into the inlet side of the turbine. Washing was carried out when the turbine had cooled to 212 deg F. This process took thirty hours but could be shortened by using the starting motors to spin the turbines and compressors. The slag was first loosened by steam from an electric boiler, after which water was squirted in while the rotor was still turning. The process took two hours. After 7,900 hours of running of the 13 MW set the blades showed no signs of corrosion.

Only three men per shift were employed at Beznau, viz. one driver and two auxiliary plant attendants. Continuous running, allowing for maintenance and repairs, would require no more than 16 men or one man per 2·5 MW of installed capacity. Maintenance costs, including replacements, for a running period of 6,000 hours worked out at 0·02d/kWh.

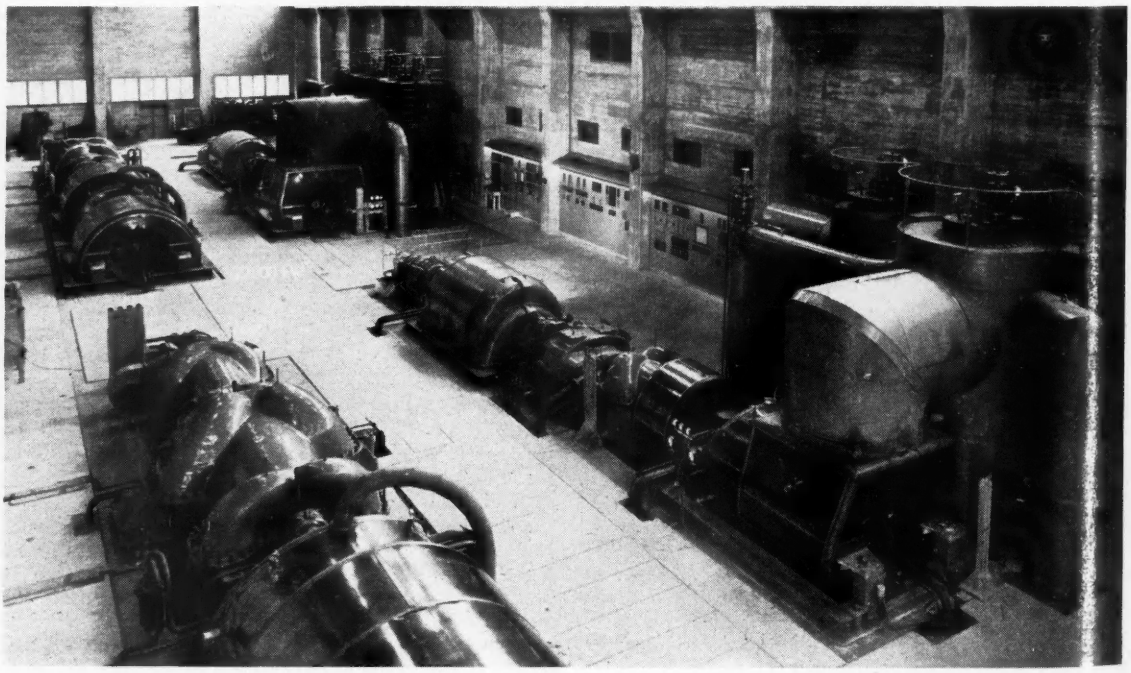
Turbines using gas fuel could be built to-day for an inlet temperature of 1,380 deg F, but for those operated with heavy residual oil the present limit was 1,200 deg F. Outputs of single-shaft sets, incorporating single-stage compression and single-stage combustion, were to-day feasible up to about 15 MW, though with two-stage compression and two-stage combustion the unit capacity could be increased to 25 MW. The output of the larger set at Beznau represented the two-fold application of the low-pressure elements of the smaller one, the high-pressure component being bigger and running at 3,000 r.p.m.

The capacity of the Beznau sets, designed for unusually low temperatures, would be about 10 per cent less if the ambient temperature were raised to 68 deg F. Some particulars of later but smaller gas turbines were included in the paper. It was stated that twelve stationary Brown Boveri units and two locomotives rated at from 1·2 to 30 MW using gas or oil fuels were now in service.

I.E.E. FARADAY LECTURE

THE Faraday Lecture of the Institution of Electrical Engineers will be delivered in London next month by Mr. O. W. Humphreys, B.Sc., F.Inst.P., M.I.E.E., director of the research laboratories of the General Electric Co., Ltd., and its title is "Electro-Heat and Prosperity." The lecture will be delivered at the Central Hall, Westminster, on Tuesday, 16th February, at 6 p.m. (doors open at 5.30 p.m.). Admission is free and applications for tickets (enclosing a stamped addressed envelope) should be sent to the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2.

The two gas turbine sets at Beznau, the 13 MW unit in front and the 27 MW set in the background



VIEWS on the NEWS

By REFLECTOR

SEVERAL of the Electricity Boards in this country have changed their method of assessing standing charges from the rateable value basis to the floor area or number of rooms system. The result has naturally been an outcry from those adversely affected. If there have been others who have derived some benefit from the change they have certainly been less vocal. Now the Irish Electricity Supply Board has decided to follow suit, as a measure of equity. Although the Board says that it expects to receive about the same revenue, it can look forward to an avalanche of complaints from those, principally in the older houses, who find their bills increased. Possibly the floor-area system is fairer than the rateable value "yardstick" but it is still an imperfect way of allocating an undertaking's standing charges.

* * *

Some strange causes of interference with broadcasting reception are reported by a special correspondent of *The Times*. In one case several residents in a village were troubled by the barking of a dog which was repeatedly heard on their radio sets. A Post Office engineer investigated the matter and eventually found the barking dog in a shed where he discovered that the earth wire of an electric pump had become disconnected but was making intermittent contact with the frame. It is said that

> "the loose contact acted as a kind of microphone, and radiation of the barking occurred through the overhead distribution wires of the local electricity supply. The trouble stopped when the earth connection was made secure.

It is also reported that a particularly baffling fault on a television receiver in Cardiff was traced ultimately to the pendulum of a non-electric grandfather clock.

* * *

We are constantly complaining in this country of what we regard as the unfair purchase tax on domestic electrical equipment. Although little consolation is to be derived from it, it is a fact that other countries have similar imposts —and they too protest. For instance, in Australia the journal *Erda* (Sydney) after bemoaning the placing of radio equipment in the maximum scale of sales tax goes on to say:—

> "In this enlightened age when the evils of household drudgery are to be avoided at all costs it might have been expected that such necessities of modern living as refrigerators, washing machines and the other labour saving devices available to the housewife would be favourably considered by the Treasurer for complete abolition of Sales Tax. Regrettably this was not so. . . . The industry will need to assert itself in a co-operative effort to bring about the reductions in sales tax to which it and the community are entitled."

With the substitution of "purchase tax" for "sales tax" and "Chancellor" for "Treasurer," this might have appeared in an E.D.A. statement.

* * *

Continuing my study of the *Electrical Review* of eighty years ago I find that the principal item in the issue of 15th January, 1874, was the presidential address to the Society of Telegraph Engineers (later the Institution of Electrical Engineers) by Sir William Thomson (afterwards Lord Kelvin). He was the third president. The bulk of his address was a study of terrestrial magnetism and electricity and he made an appeal to telegraph operators all over the world to make and record regular observations upon the polarity of the atmosphere in relation to the earth. He said that they knew by direct observation that the surface of the earth was negatively electrified, but positive electrification of the air was merely inferential. The vote of thanks to Sir William was proposed by Mr. C. W. Siemens—the first president of the Society.

In the same issue there is a note on an electric clock installed at Pittsburgh, Pennsylvania, which was said to

> "move the hands of 70 different clocks, scattered all over the city. The motive clock is powerful and has a pendulum composed of hollow coils of copper wire. These swing to and fro over the poles of horse-shoe magnets, and every time they pass from one pole to the opposite a current of electricity is called up inductively in the coils, flows up the wire and thence to the 70 dials, giving a current of an opposite nature at each swing. Behind each dial is an astatic permanent magnet, suspended on a pivot and surrounded by a coil of wire and it rotates under the electric influence from the wires."

* * *

The Bedwas and Machen Council has found that shillings are so short in the area that people are unable to obtain electricity from their slot-meter systems. It has suggested to the South Wales Electricity Board that the meters should be changed or that a token system should be instituted. This shilling shortage is no new thing; it seems to be acutest just after Christmas when no doubt much more electricity is used. It may be thought that the obvious remedy is the abolition of prepayment meters but I still think that they are necessary for people accustomed to paying as they go. A possible alternative is the half-crown stamp system for the spread-over payment of quarterly accounts which has been successful in the North Western Area.

* * *

The *Lincolnshire Echo* reports that the member for Lincoln, Mr. Geoffrey de Freitas, "has pursued with the Minister of Housing the problem of grit, smoke and spray from the cooling towers at St. Swithin's generating station." Something seems to have gone wrong with the operation of this plant—or is the B.E.A. carrying out some unusual experiments?

* * *

A forecast of conditions in 1954 is made in the January *Monthly Journal* of the Amalgamated Engineering Union. Under the heading "The Die is Cast," the journal comments: "It is true that between the casting of a die and its use there is time to consider the effect of its use." This, of course, depends on the kind of die—or dice.

The General Vector Diagram

3.—Some Examples

By M. G. SCROGGIE, B.Sc., M.I.E.E.

A PROPOSED notation and "general" form of vector diagram have been described in previous instalments* in this series: there now follow some typical examples. For brevity they will be treated qualitatively rather than (as was the original example) as a problem to be worked out quantitatively by means of the diagram alone. Fig. 20 is a reminder of the notation for voltage and current, with the addition now of flux.

The first example is a delta-connected three-phase unit, Fig. 21. In accordance with the recommended notation, the junctions and meshes have been distinctively lettered. Assuming that the phase voltages are equal, the general voltage diagram, Fig. 22 (a), is simple enough. If the corresponding current diagram is as at (b), one can deduce several things. In accordance with Fig. 20 the current through phase 1 from *b* to *a* is denoted by I_{AD}, and is represented by the vector AD; and the e.m.f. acting in the same direction is denoted by V_{ba} and is represented by *ba*. Since Fig. 22 shows that the current is flowing in opposition to this e.m.f. it must be driven by an external e.m.f.; in other words, the unit is a load, not a generator. V_{ab} is the externally applied e.m.f., and Fig. 22 shows that the current is slightly lagging. Since the diagram is symmetrical, the same conditions exist in the other phases. A "particular" vector diagram for phase 1, made by assembling the relevant vectors in radial formation, is shown in Fig. 23.

The next example is a single-phase transformer, Fig. 24, analysed in the usual manner into an ideal transformer plus primary and secondary leakage inductances (L_p and L_s) and primary and secondary loss resistances (R_p and R_s). For convenience in drawing vector diagrams the ratio is reduced to 1 : 1 by following the usual practice of dealing in volts per turn and ampere-turns. Note that the primary and secondary are shown as wound in the same direction (not as in the usual form of transformer symbol), because this is more in accordance with engineering practice and because it excludes a common cause of confusion.† If the points *a* and *e* are joined, *d* and *f* are at the same potential and can also be joined; the transformer is then nothing more than an inductive shunt, drawing off an amount of current determined by the primary inductance, i.e., the magnetizing current.

But first of all let us draw the diagram in its most general form, with an insulated secondary. We start with a known secondary terminal voltage, V_{eh}, which is represented by the vector *eh* as in Fig. 25 (a), drawn at any desired angle. The resulting load current, I_{AC}, is also assumed to be known, either directly or by calculation from V_{eh} and Z_L, and is represented by the vector AC, which of course must be drawn at the appropriate angle to *eh*; in this example it is slightly lagging.

The voltage applied to R_s (V_{hg}) must be in phase with I_{AC}, so its vector ($=I_{AC}R_s$) is drawn accordingly (Fig. 25 (b)). Similarly, V_{ef} must lead I_{AC} by 90 deg. We have now arrived at the secondary e.m.f., V_{ef}. The flux generating it must lead it by 90 deg. Now the current responsible for this flux is not the secondary current nor the primary current, but their resultant, the magnetizing current. Since the coils in Fig. 22 are in the same direction, the net current effective for magnetizing the core is $I_{BA}+I_{AC}$, so is appropriately denoted by I_{BC}; the corresponding flux is Φ_{BC}. Their common vector, BC, may now be drawn 90 deg ahead of V_{ef}. If its magnitude is known, so now is the total primary current, I_{AB}.

The core flux, Φ_{BC}, generates identical voltages (per turn) in the primary and secondary, so in Fig. 25 (c) *ad* is drawn equal to *ef* in magnitude and phase. As a concession to usual practice, the vector CB is marked "Φ" to show at once which is the phase of the flux and magnetizing current. Following the same procedure for L_p and R_p as for L_s and R_s, *dc* is drawn leading AB by 90 deg, and

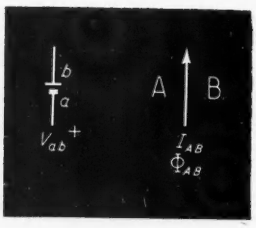


Fig. 20.—Key to the conventions adopted for voltage, current and flux

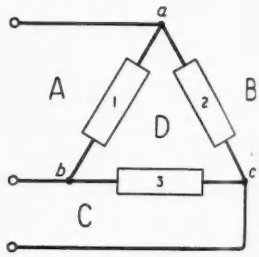


Fig. 21. — Delta-connected three-phase unit, lettered for vector diagrams

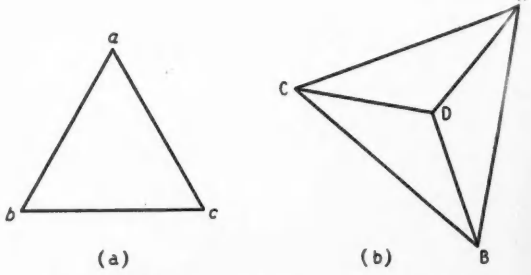


Fig. 22.—(a) Voltage and (b) current diagrams for Fig. 21

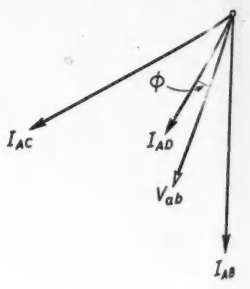


Fig. 23.—Particular vector diagram for Phase 1 in Fig. 21, derived from Fig. 22

* *Electrical Review*, 1st and 15th January.

† J. E. Parton, *Bulletin of Electrical Engineering Education*, No. 7 (Nov., 1951), p. 22.

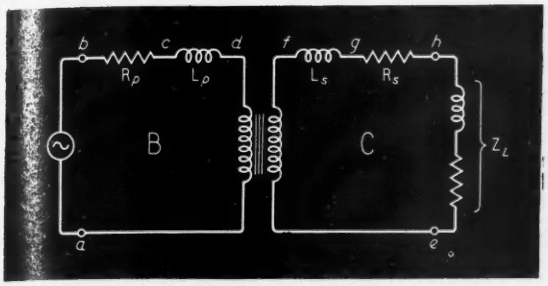


Fig. 24.—Equivalent circuit of transformer, with generator and load

cb parallel to AB, bringing us finally to the voltage V_{ab} that must be applied to the primary terminals to sustain these conditions.

If *a* and *e* are both earthed, then *ad* and *ef* in the voltage diagram coincide. Also, in drawing the practical diagram for this condition, one would probably attach the current diagram for convenience in reading phase angles. Fig. 26 shows an appropriate derivation from the general Fig. 25 (c). It embodies some familiar conventions, but retains most of the features of the general form in the voltage part, for the sake of showing relative potentials. In this particular example, however, there is less point than usual in doing so, because L_p, R_p, etc., are not physically separate components, so most of the relative potentials shown are fictitious. The chief feature about Fig. 26 that may be unfamiliar to some is the absence of unnecessary and confusing downward-pointing vectors.* As I have emphasized before, however, there is a good deal of latitude as to the exact form that the derived or particular vector diagram may take, depending largely on the facts the diagram is intended to bring out.

It is commonly held by teachers that vector diagrams are of little or no value for clarifying bridge circuits. But may not their view be prejudiced by the shortcomings of the common form and notation of vector diagrams? Before accepting it, let us try an example. Fig. 27 is the familiar Maxwell bridge for measuring inductance, shown as *L*, reckoned as being in series with its loss resistance, *r*. As a reminder of the advice to use current identifications that cannot be confused with those for voltages or components, the letters F–K have been chosen.

The aim, of course, is to balance the bridge, by adjusting C, R_3, and R_1 or R_2. When this has been achieved, $I_{GH}=0$, *b* coincides with *d*, $I_{FG}=I_{FH}$, and $I_{KG}=I_{KH}$. Let us start with I_{HF}, drawing HF as the reference vector, Fig. 28 (a). Because $I_{GH}=0$, G coincides with H. This corresponds in Fig. 27 with ignoring the boundary between G and H—the detector arm, whose presence of course makes no difference when the bridge is balanced. The voltage vector *cd* can now be drawn; it is in phase with

* J. E. Parton, *loc. cit.*

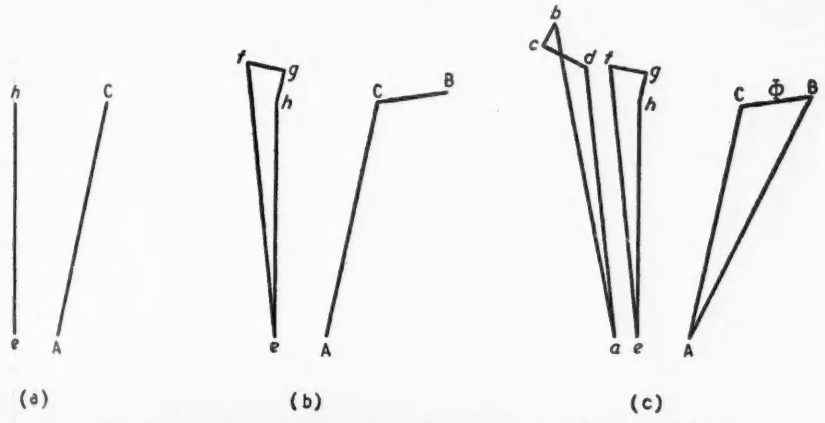


Fig. 25.—Progressive construction of voltage and current diagrams for Fig. 24

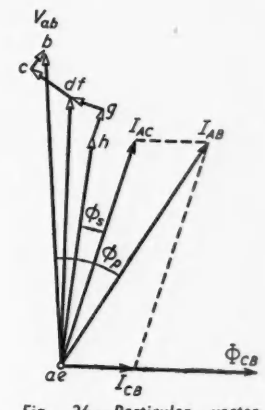


Fig. 26.—Particular vector diagram derived from Fig. 25 (c)

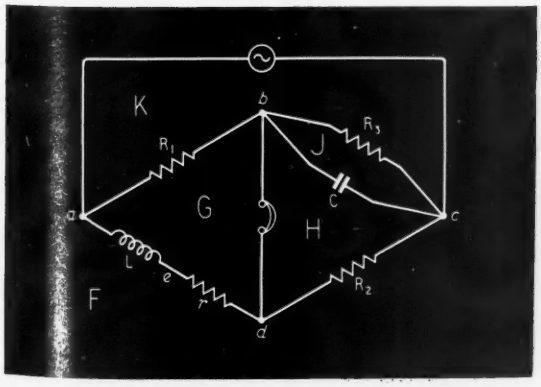


Fig. 27.—Maxwell bridge circuit

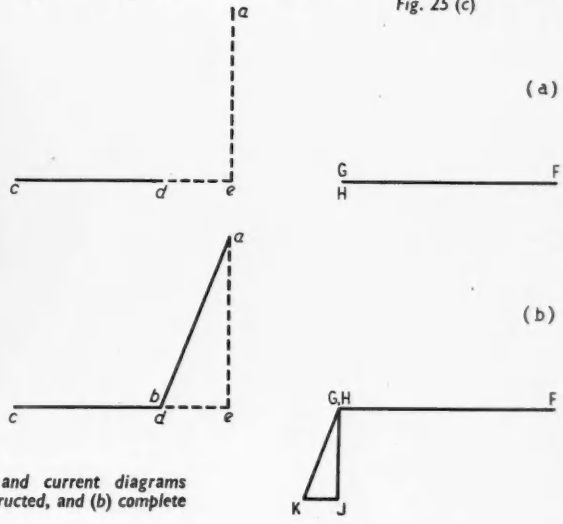


Fig. 28.—General voltage and current diagrams for Fig. 27: (a) partly constructed, and (b) complete

HF. So is *de*; but *ea* must lead GF by 90 deg. These two vectors are shown dotted, because they represent voltages that have no separate existence but are merely the in-phase and quadrature components of the voltage V_{da} across the coil being measured.

Since at balance *b* coincides with *d*, KG can now be drawn—in phase with *ba*, as in Fig. 28 (b). KH is of course equal to KG, and is made up of two components: KJ in phase with *cb* and JH leading it by 90 deg. The source voltage and current are represented by *ac* and FK, respectively, but as these are of relatively little interest their vector lines have been omitted, so as to focus attention on the important matter of balance conditions.

It is clear that the construction, based on these conditions, necessarily makes *aed* and HJK right-angled triangles that are similar (in the mathematical sense). Therefore

$$\frac{ae}{ed} = \frac{\text{HJ}}{\text{JK}}$$

Since *ae* and *ed* are proportional to ωL and r, and HJ and JK are proportional to ωC and $1/R_3$,

$$\frac{\omega L}{r} = \omega C R_3$$

$$\therefore \quad L = C R_3 r$$

Incidentally, the physical interpretation of these triangles is that at balance the power factor and dissipation factor of the C and R_3 arm are the same as those of the coil being measured. These two arms are " duals " of one another.

Another equation is needed in order to determine L and r. An obvious condition for balance is

$$\frac{ab}{bc} = \frac{ad}{dc}$$

If the impedance of the capacitive arm is called Z_C and that of the inductive arm Z_L, then

$$\frac{R_1}{Z_C} = \frac{Z_L}{R_2}$$

$$\therefore \quad R_1 R_2 = Z_C Z_L = \frac{bc}{\text{HK}} \cdot \frac{ad}{\text{FG}}$$

The vector diagram shows that $ad/\text{HK} = ed/\text{JK}$, so

$$R_1 R_2 = \frac{bc}{\text{JK}} \cdot \frac{ed}{\text{FG}} = R_3 r$$

Combining this result with the previous one,

$$L = C R_1 R_2 \text{ and } r = \frac{R_1 R_2}{R_3}$$

Graphical representation of the bridge-arm impedances in a diagram such as Fig. 28 (b) can hardly fail to help one visualize the conditions needed for balance. This general type of vector diagram accentuates the analogy between the mathematical and physical relationships. The fact that the relative positions of points on it indicate directly the relative potentials of similarly-labelled points in the circuit is clearly an advantage when studying bridges in which the aim is to bring two points to the same potential. It is perhaps even more helpful in valve circuits, for these tend to become complicated, and relative potential—on which most ordinary vector diagrams fail to yield explicit information—is of prime importance. So, although study of the Maxwell bridge could profitably be continued to include out-of-balance conditions and the effects of varying the network parameters, it is time to take an example of a valve circuit, Fig. 29.

This is a simple arrangement, with a signal fed in at the grid, and a tuned anode circuit. To make it simpler still we shall assume that the signal-frequency impedances of the cathode-resistor by-pass and the anode power-supply by-pass are small enough to be neglected, and that the anode circuit is exactly in tune with the signal frequency. A preliminary process is to redraw the circuit diagram, retaining only the features relevant to the signal frequency —for no others can be represented in the vector diagram— and replacing the valve by its " equivalent," consisting of either a voltage or a current generator, in series or in parallel respectively, with its internal resistance. In Fig. 30 the voltage generator is shown, with the internal resistance r_a in series. The voltage is μ times that applied to the grid, and on the usual assumption that the anode and grid voltages are reckoned with reference to the cathode the sign is negative. It is also assumed that the valve is linear and that grid current is negligible.

The first step with the vector diagram (Fig. 31) is to draw *eg* to represent the grid voltage. The little circle around point *e* signifies that it is conventionally the centre of rotation, on account of *e* in the circuit being earthed. Next draw *eb*, μ times the length of *eg*, in the opposite direction. Since the anode circuit is exactly tuned, it is (as a whole) purely resistive, so draw HJ in phase with *eb* to represent the anode current. For the same reason the impedance of this circuit will be at its maximum, so a short current vector is appropriate. The voltage dropped in the valve, V_{ba}, is opposite in phase to I_{HJ}, so *a* is somewhere on *be*.

The superior clarity and neatness of the recommended

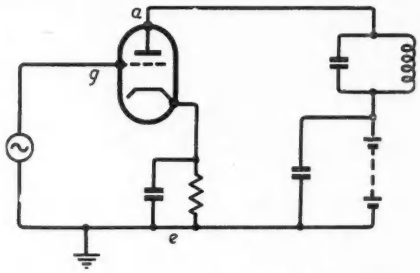


Fig. 29.—Typical valve circuit with tuned anode

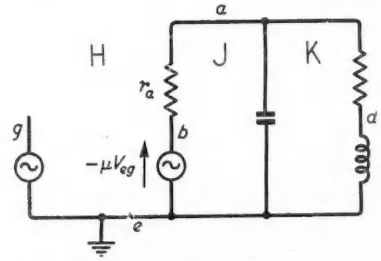
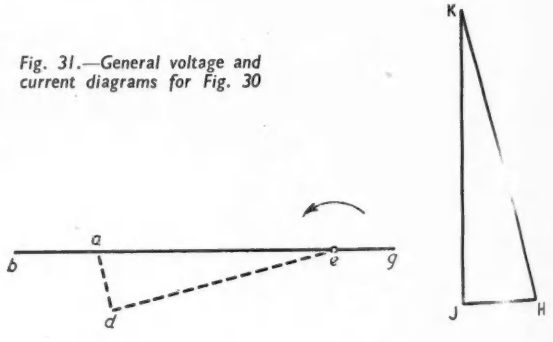


Fig. 30.—Fig. 29 redrawn for vector analysis with the valve replaced by its approximately equivalent generator

Fig. 31.—General voltage and current diagrams for Fig. 30



style of vector diagram is especially marked when, as here, a number of vectors lie along the same line.

So far the tuned circuit has been taken as a whole, equivalent at the signal frequency to a high resistance. It only remains to show the separate branch currents, I_{JK} and I_{KH}. Neglecting capacitor losses, I_{JK} is 90 deg ahead of the voltage applied to it, V_{ae}, so draw JK at right angles to JH. The tuned-circuit losses are represented by the resistance shown in series with the inductor in Fig. 30, so I_{KH} is somewhat less than 90 deg behind V_{ae}. The actual angle appears in the vector diagram as ∠JHK, and it is clear that the nearer this is to 90 deg the longer are JK and HK in comparison with JH; this illustrates the physical fact that the lower the tuned-circuit losses the greater the current circulating around it in comparison with that fed in, i.e., the greater the Q or magnification factor. The back e.m.f. V_{ed} generated by the inductance when I_{HK} flows leads the current by 90 deg, so to represent it draw *ed* 90 deg ahead of HK. The position of *d* is fixed by the fact that V_{da} is in phase with I_{HK}. These lines are drawn dotted to emphasize that they have no separate existence; point *d*—and point *b* too—are not accessible to instruments!

To get the full educational benefit from the diagram, one would have to draw it to scale from given or assumed valve and component values. However, even qualitatively it is very instructive. One point that is clear is that the input signal voltage cannot be obtained directly from any point on the anode circuit, for all are 180 deg out of phase. But a coil coupled to the anode coil can be so connected as to provide a signal voltage nearly in the correct phase. Since such a voltage is generated by the same flux as V_{ed}, it must be either in phase with V_{ed} or 180 deg opposing it, and as the coil losses cannot be eliminated entirely it might seem that even 180 deg phase shift could not bring it in phase with V_{eg}.

But if a new diagram is drawn, with *ed* 180 deg from *eg*, the required condition is fulfilled, on paper at least. This brings point *a* off the line *eb*, but such a condition can be physically realized by tuning the anode circuit slightly off resonance. The whole situation is shown in Fig. 32. By adjusting the capacitance, V_{ef} can be brought into phase with V_{eg}, and by varying the mutual inductance between the coils V_{ef} can be made equal in magnitude to V_{eg};

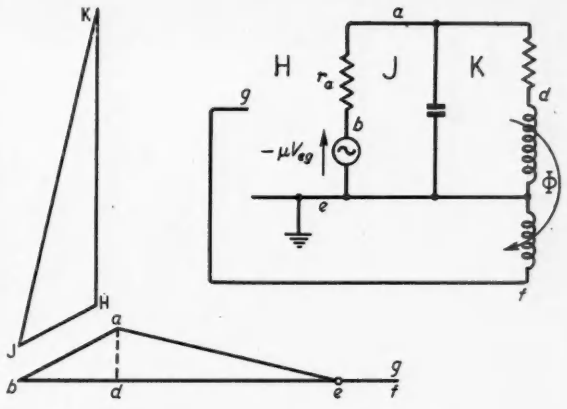


Fig. 32.—Modification of Fig. 29 to produce self-oscillation, and the corresponding general vector diagram

these two adjustments having been made, point *f* coincides with *g*, and the external signal generator can be removed, for the required input voltage is now provided from the output. In other words, the system is now a self-oscillator. Note that under oscillating conditions the anode of the valve is *not* 180 deg out of phase with the grid. The two conditions described go most of the way towards the general expression of the conditions for oscillation known as the Nyquist criterion.

These are only a few and quite possibly not the best examples that could be chosen to illustrate this system of vector diagrams. If I have explained such elementary examples in what may seem to be childish detail it was not with the object of insulting readers' intelligence, but in the belief that any unfamiliar set of conventions is apt to be baffling, and that it is advisable at first to try it on examples that offer no difficulties in themselves to divert the mind from the main business. Then, when the new conventions have themselves become familiar enough to be used with confidence, they can be put to real work in dealing with problems that are difficult. The more complicated the circuit, the greater are the advantages of the method that has been put forward in this series of articles.

Electricity in Northern Ireland

IN a lecture to the Belfast Association of Engineers on 6th January, Mr. T. G. Christie, chief engineer, Electricity Board for Northern Ireland, reviewed the progress made in the second decade since the establishment of the Board by the 1931 Act and since the passing of a further Act in 1948. After describing the methods adopted for safeguarding electricity supplies in Northern Ireland as a whole during the war, including the construction of Ballylumford power station for the Board and extensions at Belfast Corporation's Harbour power station and Londonderry Corporation's power station, the lecturer turned to post-war developments. The outputs of these stations in 1952 were: Belfast Corporation, 383 million kWh (m.d. 123 MW), Electricity Board, 398 million kWh (m.d. 124 MW) and Derry, 25 million kWh (10 MW). Consumers in the Board's areas (the whole of Northern Ireland except Belfast and Londonderry) numbered 117,000, of which 45,000, including 6,500 farms, were in rural districts. The total compared with 131,000 in Belfast and 11,700 in Londonderry. During the ten years since 1942 the mileage of the Board's 110 kV and other high voltage lines was increased from 830 to 2,634, which was accompanied by an increase in low voltage distributors from 536 to 1,720 miles.

A statutory committee (consisting of the chief engineers of Belfast and the Board and an independent chairman appointed by the Ministry of Commerce), which was set up under the Act of 1948, recommended the provision of a new power station at Victoria Channel, Belfast, to have an ultimate capacity of 240 MW. A 30 MW set was due for commissioning next autumn and a second next year. Two 60 MW sets were also proposed for later installation. Other schemes accepted by the Ministry were for hydro-electric stations on the Bann near Carnroe (Kilrea) (15 MW), on the Mourne at Mulvin (18 MW) and at Sion Mills (10 MW).

Progress in Electrical Research

Survey of Recently Published E.R.A. Reports

THE accurate quantitative estimation of comparatively large amounts of iron in copper is described in B.S. 1800: 1951. This method is less suitable for the roughly quantitative detection of amounts below 50 parts per million. The method described in Report Ref. A/T130, "The Detection of Very Small Amounts of Iron in Electrolytic Copper," by P. Armes, B.Sc. (3s), which has just been published by the British Electrical and Allied Industries Research Association, is similar in principle to the B.S. method, but it is somewhat simpler and gives a more obvious response to the presence of iron in amounts around 5 parts per million. It is not intended to give accurate quantitative results.

The deep red coloration produced with ammonium thiocyanate solution provides a sensitive test for the presence of ferric iron. The sensitivity of the test is greatly reduced, however, in the presence of large amounts of copper, and is unsuitable for the detection of iron as an impurity in electrolytic copper unless copper is first removed from the solution. After copper has been removed in solution by filtration, the iron is retained as the hydroxide by adsorption on filter paper. The latter is then treated with ammonium thiocyanate to develop a visible coloration. This method is capable of detecting less than 0·01 mg Fe.

Corrosion of Earth Electrodes

Earth electrodes usually take the form of buried copper or ferrous strips, plates, rods or pipes, and a method sometimes used to reduce the resistance of such earth electrodes is to treat the surrounding soil with common salt. The salting process may be applied once only, to reduce the resistance while the electrode is settling down, or alternatively the electrode may be resalted at, say, yearly intervals. There has been, however, reason to suspect that salting accelerated the corrosion of the electrodes.

To investigate the general question of corrosion of earth electrodes, excluding the grosser forms of electrolytic corrosion, an extensive survey was made covering soils of different types, in which were buried specimens of different metals normally in use for earth electrodes. In each soil both salted and unsalted sites were used. The tests covered exposures up to twelve years and the results are recorded in Report Ref. V/T110, "Corrosion of Buried Copper and Ferrous Strip in Natural and Salted Soils" (10s 6d).

Radio Interference Measurement

The anticipated rapid expansion of the television service has prompted the German authorities (F.T.Z.) to consider the introduction of regulations for the control of interference from motor vehicles. Measurements made using equipment built by Messrs. Rohde and Schwarz for the F.T.Z. have been compared with data obtained in Great Britain using the Post Office measuring set R12. Difficulties have been experienced both in Germany and in Great Britain in correlating the data obtained in the two countries. Tests were therefore arranged through the offices of Joseph Lucas, Ltd., and the E.R.A. in Great Britain and the Bosch Co. and F.T.Z. in Germany to compare the behaviour of the British and German measuring equipment.

Report Ref. M/T123, "Radio Interference from Motor Vehicles. Comparison of British and German Measuring Equipment," by A. H. Ball, A.M.I.E.E., and S. F. Pearce, B.Sc., F.Inst.P. (10s 6d), summarizes the results of tests carried out in January, 1953, at the F.T.Z., Darmstadt, and indicates the reasons for the differences in indication of the two equipments when measuring the field radiated from the ignition system of a motor vehicle.

Superheater Tubes

A study has been made of the effect of aluminium and of heat treatment on the creep properties and structural condition of low carbon steel superheater tubes. The steels were examined in the "as pilgered," "as hot reduced" and "as cold drawn" conditions and after a "sub-critical anneal," a "close anneal" and also after a "normalizing treatment" in each case. This work is described in Report Ref. J/T155, "The Influence of Various Heat Treatments on the Properties of Low Carbon Steels intended for Superheater Tubes," by D. C. Herbert, B.Sc. (Eng.), and E. A. Jenkinson, M.Sc. (Eng.), A.I.M. (10s).

Steels for Steam Plant

Report Ref. J/T152, "A Review of Work carried out at the National Physical Laboratory on the Creep and Corrosion Resistance of Steels for Steam Power Plant, 1930 to 1949," by A. M. Sage, B.Sc., A.I.M. (18s), briefly reviews the work of the E.R.A. from 1930 to 49, attention being drawn to the reasons for the various lines of investigation undertaken. The present position of work still in progress is also reviewed and mention is made of work about to be started.

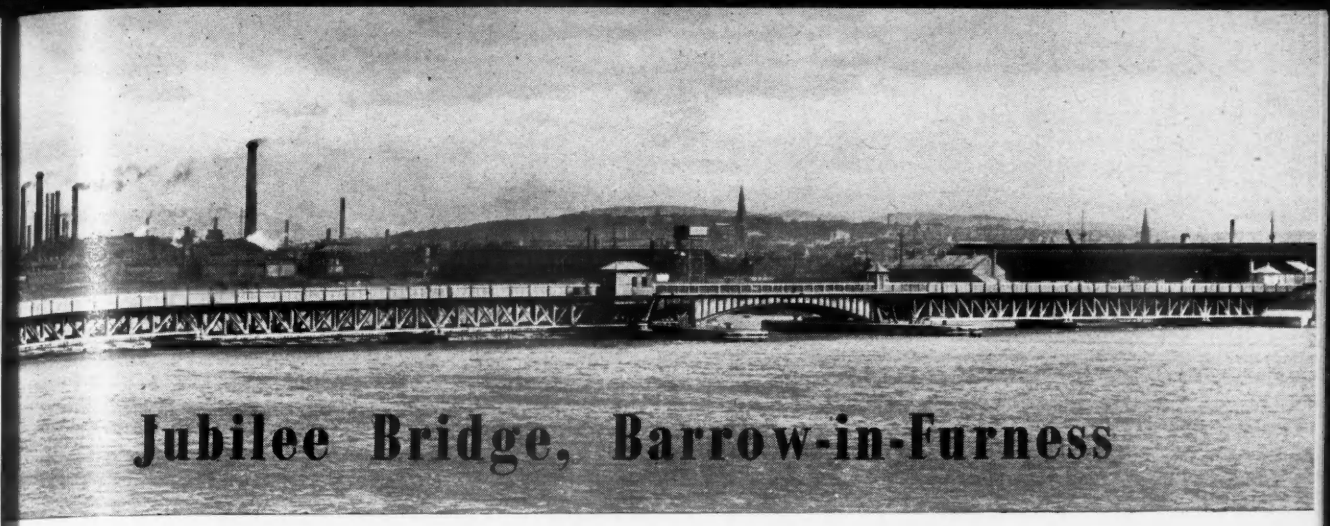
Intrinsically Safe Apparatus

Report Ref. G/T282, "Intrinsically Safe Electrical Apparatus: Relation of Igniting Current to Circuit Inductance for Inflammable Mixtures of Calor Gas (Butane) and of Cyclohexene with Air," by E. M. Guenault, M.Sc., Ph.D., E. Atherton and F. Shaw (6s), covers the determination of the range of mixtures of Calor gas (butane) and of cyclohexene, with air, which are most readily ignited by the type of sparks produced when an inductive circuit is rapidly broken. The relation of igniting currents to circuit inductance for such mixtures has been established. The results show that the ignitability of these mixtures does not differ appreciably from that of the most readily ignitable mixture of pentane and air. The investigation was made at the S.M.R. Establishment of the Ministry of Fuel and Power at Sheffield.

Copies of the above publications are available, at the prices indicated, on application to the E.R.A. at Thorncroft Manor, Dorking Road, Leatherhead, Surrey.

B.R.A. LUNCHEON

THE British Refrigeration Association announces that its next annual luncheon will be at the Connaught Rooms (Grand Hall), Great Queen Street, London, W.C.2, on 19th March at 12.30 for 1 p.m. The principal guest will be Lord Mancroft.



Jubilee Bridge, Barrow-in-Furness

Modernized Electrical System

THE Jubilee Bridge, Barrow-in-Furness, which spans the Walney Channel between Walney Island and the mainland at Barrow, first opened in 1908, was recently officially reopened by Alderman A. L. Hearsey, J.P., Mayor of Barrow-in-Furness, after modernization of the operating equipment associated with the double bascule opening span. All the electrical drives and cabling have been replaced, and a new control system embodying the Ward-Leonard principle has been designed to enable the complete sequence of operations necessary when raising or lowering the bridge to be fully automatic and under the control of a single handwheel. The whole of the electrical equipment was supplied by the General Electric Co., Ltd.; the mechanical engineering was carried out by Vickers-Armstrongs, Ltd.; and the Blackburn office of W. H. Smith & Co., Electrical Engineers, Ltd., the main contractors, was responsible for the complete installation.

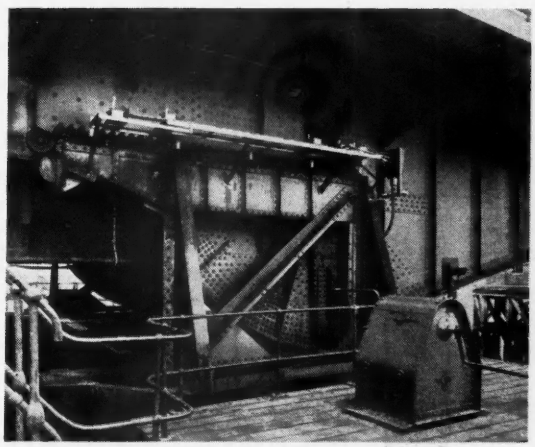
The total length of the bridge is over 1,100ft, comprising eight fixed spans, ranging from about 83ft to 118ft clear, and an opening span of 120ft which, when closed, gives a clear headway of 18ft above high water level. The two leaves of this opening span operate on the Scherzer rolling lift system.

The rear part of each side of the leaf is formed as a segmental girder which rolls on a longitudinal track, rectangular holes being milled in the curved plate covering each segment to correspond with projections on the track plate. The main driving motor, mounted inside the leaf, is coupled through gearing to a driving shaft carrying two pinions, one on each side of the leaf. Each pinion engages a longitudinal rack rigidly supported on a framework attached to the piers of the bridge. When the motor is energized and the shaft rotates, the thrust of the pinions against the teeth of the racks is sufficient to cause the segments to roll along the tracks, thus tilting the leaf in a manner similar to the action of a rocking chair.

The raising operation carries the whole leaf back from the opening of the bridge and, as a result, a tilt of less than 75 deg is required to give a clearance through the opening which, in the case of an ordinary bascule bridge, would necessitate raising the leaves through an angle of 90 deg. Further, by the provision of balance weights the centre of gravity of the leaf is situated at the rear of the bridge seat, thus reducing to a minimum the power necessary to raise and lower the bridge.

When the bridge is in the fully closed position the rear end of each leaf enters an inverted stirrup formed upon an extension to the adjacent fixed span. In order to lock the leaf in this position and to prevent it from deflecting under passing loads, two powerful eccentric locking pawls are provided, the shaft actuating the pawls being driven, through worm gearing, by a small motor attached to the fixed span. Rotation of the eccentric shaft drives the pawls home against seatings on the rear ends of the main girders of the leaf.

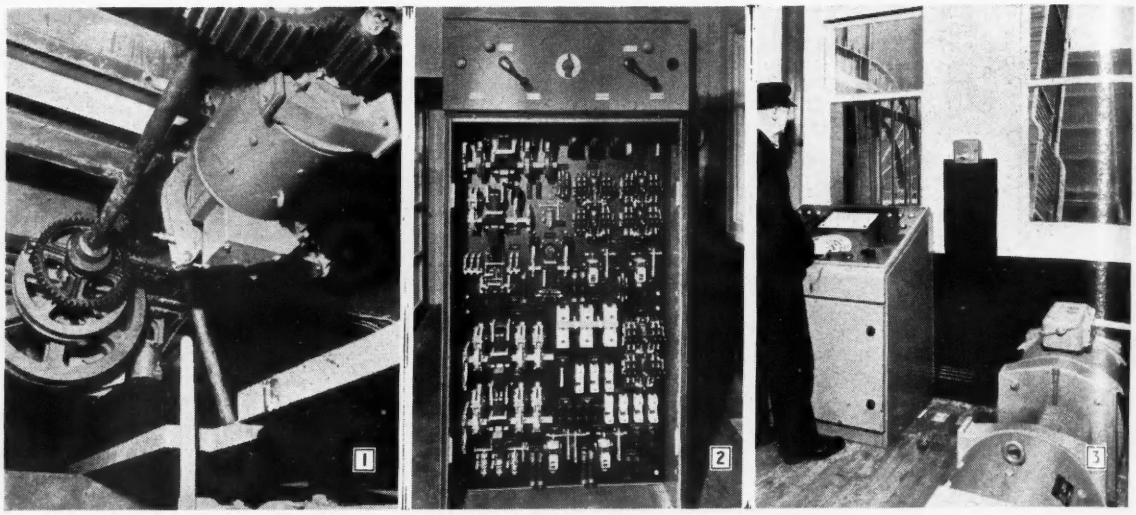
Each leaf of the opening span of the bridge is powered by a 25 h.p. 400 r.p.m. d.c. totally enclosed motor mounted inside the leaf, the armature being supplied, through flexible cable, from its own Ward-Leonard motor generator set which is installed in a control cabin adjacent to the rear end of the leaf concerned. A stand-by motor is also provided on each leaf. Each Ward-Leonard set comprises a 35 h.p. 1,450 r.p.m. 3-phase squirrel-cage motor directly coupled to a 0/22 kW 0/440 V d.c. generator. The motor is energized at 400 V from the local 50 c/s supply mains, while the 230 V d.c. supply to the generator field circuit is obtained by means of a 3-phase transformer-rectifier unit which also provides the excitation for the leaf motor and the magnetic brake solenoids.



The rear end of each leaf enters an inverted stirrup formed upon an extension to the adjacent fixed span; note limit switches beside longitudinal track

The rear locking device on each leaf is driven through worm gearing by a 1 h.p. 1,450 r.p.m. s.c. motor which is connected through reversing contactors to the 400 V 3-phase supply.

Traffic gates are provided at each end of the opening span and are closed by hand before the bridge is raised. Red lights mounted on each gate and bells on each approach



1. Each leaf is operated by a 25 h.p. motor mounted inside the leaf. 2. Main and auxiliary isolators and fuses for the incoming supplies to the machines are mounted on the Barrow control panel. 3. The operation of the whole equipment is controlled from the operator's desk on the Barrow side of the bridge

automatically give warning to road traffic as soon as the sequence of operations for opening the bridge is initiated. Shipping in the channel is informed of the position of the opening span by means of two solenoid-operated semaphores.

All the control gear necessary for the operation of the bridge is installed in the two cabins adjacent to the ends of the opening span. Two sheet steel control panels, one in each cabin, house the starters for the Ward-Leonard m.g. sets, the control gear for the generators, leaf motors, locking motors and magnetic brakes, and the transformer-rectifier units which provide the 230 V d.c. supplies. The operation of the whole equipment is controlled from the operator's desk on the Barrow side of the bridge.

Main and auxiliary isolators and fuses for the incoming supplies to the machines and to the various control and cubicle heating circuits are mounted on the Barrow control panel which also houses the main line contactor which must be closed before any of the motors can be started. The " start " and " stop " push-buttons which control the operation of this contactor are mounted on the desk, and, in addition, an " emergency stop " push-button is provided in each cabin. The starters for the driving motors of the Ward-Leonard sets are of the automatic star/delta type. The Walney set starts as soon as the operator presses the " start " push-button, but a timing device delays the starting of the Barrow set for a few seconds in order that the peak starting currents for the two driving motors shall not occur simultaneously.

Both leaf motors are provided with two-stage overload protection. For comparatively small overloads the first stage relays operate to reduce both motors to creeping speed. For heavier overloads, however, the second stage relays come into operation and disconnect the machines from the supply. The stand-by motor on each leaf can be connected in circuit from the Barrow cabin, the change-over switch for the Barrow machines being mounted on the control panel, and that for the Walney motors on the operator's desk.

The sequence of operations necessary for either raising or lowering the bridge is initiated from the desk by means of a single master controller, a " raise/lower " selector switch being provided to set the controller for the duty required.

The main supply is brought into the Barrow control cabin, which is connected to the cabin on the Walney Island side by four submarine cables. One length of 4-core cable carries the main a.c. supply while the connections for the auxiliary, limit switch and interlocking circuits consist of 15-core and 20-core p.i.l.c. double wire armoured and served cables.

The armature and field supplies for the leaf motors are carried from the marshalling kiosk by 4-core paper-insulated cables which terminate in special waterproof connection boxes on the ends of the fixed spans. From here, single-core flexible v.r.i. cables are taken to similar connection boxes, mounted on the leaves of the bridge, and these are connected to the motor terminals by further lengths of 4-core cable. All the cables in this installation were manufactured by Pirelli-General Cable Works, Ltd.

Domestic Refrigerators

A DETAILED description of the manufacturing processes for each of the main components (excluding the cabinet) of small household refrigerators was given in a paper presented by Mr. S. H. Pearson (L. Sterne & Co.) on 12th January at the Institution of Engineers and Shipbuilders in Scotland.

The compressor considered was of the reciprocating type with connecting rod. The other chief parts making up the refrigeration unit were: the air-cooled condenser in which the temperature of the refrigerant gas was reduced (almost always by atmospheric air circulation) to liquefaction; the evaporator in which the liquid changed under pressure into vapour, taking heat from the surrounding air; and the regulator, generally in small sets a fixed throttle in the form of a capillary tube. The need for exacting standards and finish for a compressor, for example, was that in five years (often covered by a guarantee) it would run for about 11,000 hours, assuming it to be in operation for a quarter of the time. As the unit was hermetically sealed any mechanical repairs would have to be carried out in specially equipped premises.

Particulars were given of the steps taken to eliminate the commonest source of trouble, viz., moisture (even in minute quantities) which might, for instance, be present in the refrigerant or in the lubricating oil.

Wool Textile Industry

Increased Output Through Electrification

THE leading part that electricity can play in increasing the efficiency of working and the output of each operative in the wool textile industry was the subject of an integrating paper presented last evening before the Utilization Section of the Institution of Electrical Engineers by Messrs. A. J. Francis and T. H. Carr (Yorkshire Electricity Board). In 1951, the authors stated, the industry was the fourth largest exporting industry in Great Britain, being responsible for 8 per cent of the total value and 17·5 per cent of the dollar exports.

Of 75,000 looms in 1951 12 per cent were automatic (i.e. not requiring an operative's attention in replenishing the weft) compared with 83 per cent of 35,000 in the United States in 1940. Their high capital cost necessitated two-shift working to make their use economical. Power and fuel costs in the industry formed but a small proportion of the whole cost of production and by far the most important consideration was the effect of driving methods and their reliability, since short stoppages could be very costly. A small increase in output might justify high expenditure or even an increase in driving costs. With present prices of coal, electric driving from the public supply was generally cheaper than the employment of steam engines.

The industry was divisible into two main sections, worsted and woollen—the difference being in the manufacturing process from raw wool to yarn. Particulars and tabulated data were given of the raw materials and processes adopted in manufacture and of the electrical requirements of typical cases in relation to the driven machinery.

In post-war years progress had been restricted by plant and machinery shortages and to-day probably over 40 per cent of wool textile plants were still unelectrified. Steam was required for process and space heating in amounts that varied greatly, the peak demands for which were often not simultaneous with those for power. The use of thermostatically controlled electric heaters for wool wash bowls and back-washers and possibly for Noble-comb circles was worth consideration.

Individual drives were most advantageous in the weaving, spinning and finishing branches, but even in the combing and other preparatory processes, where machines were operated in groups, the absence of overhead shafts and belts would usually justify this method; differences in energy consumption were small. Electrical demands of most wool textile mills varied between 100 and 1,000 kVA. Mills having a demand in excess of 1,000 kVA generally required two or more transformers feeding medium voltage switchboards normally isolated but capable of being interconnected.

ELECTRICAL DEMANDS FOR WOOL TEXTILES IN ONE DISTRICT
(Includes lighting, heating and power)

Section of Industry	Demands exceeding 100 kVA	Demands not exceeding 100 kVA	kVA Total
	kVA	kVA	
Spinning	11,300	1,100	12,400
Combing	2,600	900	3,500
Weaving	2,300	1,640	3,940
Dyeing	1,950	500	2,450
Warehouses	—	1,500	1,500
			23,790

Most textile processes demanded a high visual effort for production of quality and quantity of product. Illumination values of 10 to 12 lumens per sq ft in spinning, 18 to 30 in weaving and 30 to 50 for cloth inspection, burling and mending, and higher values for very fine and dark materials, were recommended. Positioning of lights was important, especially in weaving sheds, for immediate

Fig. 1.—Growth of consumption of electrical energy in the wool textile industry (Board of Trade Census of Production)

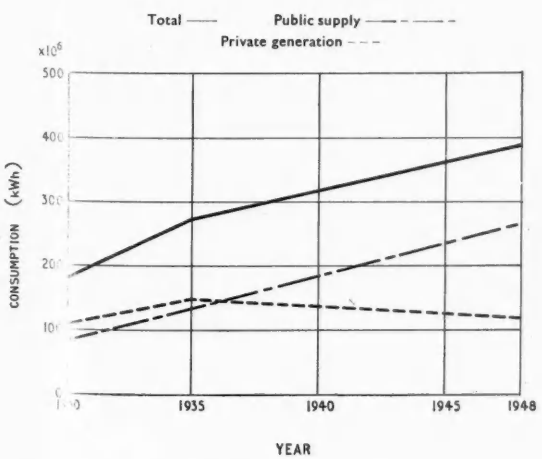
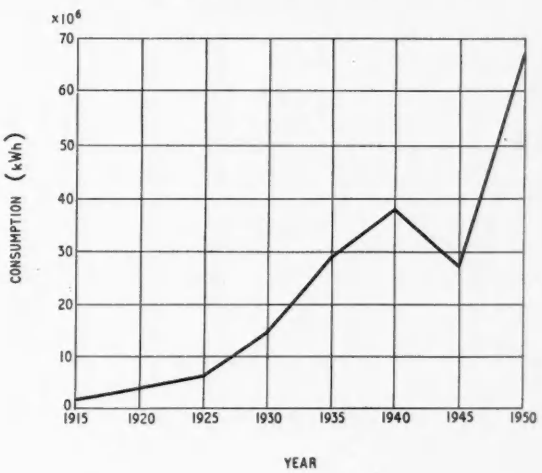


Fig. 2.—Electricity taken from public supply by the wool textile industry of Bradford (the centre of the worsted section)



discernment of faults and for location and repair of broken threads. The 5ft fluorescent lamp had helped to provide the luminous intensities required without dazzle or shadow effects. Mechanical runways with electric lifting blocks and bale lifters for stacking were used in progressive mills, but much scope remained for the application of mechanical handling in many sections of the industry. Many looms were now fitted with electrically operated warp stop motions, which were also being applied to existing non-automatic looms. Warping machines were also being equipped with means of stoppage when a thread broke. Manual guiding of cloth on tenterers, which limited the speed of a machine to the skill of the operatives with risk of irreparable damage to the cloth, was being superseded by automatic methods. These reduced the number of attendants feeding the material to one from three and could increase the rate of 25 or 30 yd/min to 70 or 80 yd/min. On drying machines electronic devices gave a continuous indication of the condition of the material on leaving. There appeared to be much further scope for the application of air conditioning.

NEW BOOKS

Electronic Engineering Principles. By John D. Ryder. Second edition. Pp. ix + 505; figs. and index. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 37s 6d.

This is the second edition of a book which was first published in America; the author is a professor at the University of Illinois. The treatment of the subject is more or less conventional; perhaps rather more than a quarter of the book is occupied with basic theory, the rest deals with some of the more important electronic devices. There are good—if not exhaustive—discussions, for example, on cathode ray tubes, diodes, triodes and multi-electrode thermionic vacuum tubes generally, gas-filled valves and photoelectric cells. There are two chapters giving the usual treatment of thermionic valve amplifiers. There is also a chapter on semi-conductors, which is adequate as an elementary introduction to point contact and junction devices. At the end of each chapter is set a large number of problems and exercises. Adequate references, mostly American, are supplied.

There is no attempt to give, as is so often done, an unnecessarily large amount of theory, which is either too superficial to be of any use at all, or else is badly chosen. What is given is well selected, and placed in some relation to the discussion on the devices; a minor lapse would seem to be the page or two on the neutron, positron and other particles. The book has the further virtue of not trying to crowd between its covers a description of every device which could conceivably be called electronic. The printing and diagrams, and in fact the production generally, are good, as indeed they should be in a book of this size on this subject at this price.—V.J.F.

Faster Than Thought. Edited by B. V. Bowden, M.A., Ph.D. (Cantab). Pp. 416; figs and index. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 35s.

Dr. Bowden's writings are just the same as his public, and not so public, speeches. This book is no exception and there are many interesting and amusing anecdotes interwoven into the main text, mostly relevant. There are twenty-four contributors, all experts in the British field of electronic digital computation and each writes on one aspect or about one machine. However, the editing is superb and one can hardly believe that there are in fact so many different authors.

The book is divided into three parts, the first being a historical introduction to the conception and construction, including the theory, of computing machines. There is one chapter on the electronic circuitry forming the basic units. Those not interested in the electronic side can leave this out without loss of continuity. The following chapter shows how the various functional units are organized to enable computation to take place. The rest of Part One deals with construction, performance and maintenance of electronic digital computers; and an introduction to the methods of programming problems for presentation to the machine.

Part Two is entitled "Electronic Computing Machines in Britain and America." Eight chapters describe eight British machines and a ninth describes the same number of the more famous American computers. This is just as it should be, for the British machines have had relatively little publicity.

The last part is devoted to the uses to which these machines are being put and describes their growing use in the various fields of logic, physical chemistry, meteorology, ballistics, engineering, business, commercial and government calculations, statistics, economics, astronomy, etc. Included in this section as an illustration is a flow sheet for P.A.Y.E. calculations. The whole of this part makes one realize the enormous extent to which these machines are rapidly becoming accepted as practical necessities.

As a summary, a quotation from the foreword by the Earl of Halsbury, managing director of the National Research Development Corporation, will suffice: "It is undoubtedly the best general account yet written. There is something in it for everyone."—J.C.W.

BOOKS RECEIVED

Statistical Methods in Electrical Engineering. By D. A. Bell, M.A., B.Sc. (Oxon), Ph.D., M.I.E.E. Pp. 175; figs. and index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 25s.

Data and Circuits of Television Receiver Valves. By J. Jager. Pp. 216; figs. and index. Philips Technical Library. Cleaver-Hume Press, Ltd., 42a, South Audley Street, London, W.1. Price 21s.

Electricity and Magnetism. By E. R. Peck. Pp. 476; figs. and index. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4. Price 60s in the United Kingdom.

Introduction to Power System Analysis. By F. S. Rothe. Pp. 187; figs. and index. Chapman & Hall. Price 40s.

Gears for Small Mechanisms. By W. A. Davis. Pp. 157; figs. and index. N.A.G. Press, Ltd., 226, Latymer Court, London, W.6. Price 25s.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Training Within Industry

REFERRING to the letter from " L.E.D. " in your issue of 1st January, I would say that with some essential modifications T.W.I. need not be a waste of time for supervisory staffs.

Generally speaking, the methods expounded are irrefutable, but it is important to appreciate that in no way do they constitute a new discovery in the arts of administration and supervision. I would consider that results of great value might accrue if these methods were followed throughout all grades of managerial and supervisory staffs in the electricity supply and manufacturing industries. However, the courses prepared by the Ministry in the form of " briefs " for use by group leaders appear to be addressed to semi-literate persons of doubtful intelligence and I feel sure that this form of presentation will be resented by professionally qualified men everywhere.

Various organizations such as the E.P.E.A., the Engineers' Guild and the professional institutions strive continuously in their respective fields to maintain and improve the status of the engineer and I think that at this stage of his development he is entitled to expect from his principal administrators a greater respect for the general level of his intelligence and attainment than is evident in these courses.

In my opinion the courses should be re-edited with a view to making them suitable for presentation to men with adult minds and the courses as now available should be retained only for those whose principal source of reading is the comic strip and the sensational headline.

" B.E.A. ENGINEER."

Legislation and Metering Costs

MR. CROWSLEY, whose letter on this subject appears in your issue of 15th January, appears to be living in an economic " cloud cuckoo land."

There is certainly no need to introduce legislation to reduce interest charges on loans required by the industry; the B.E.A. can fix the interest terms on loans which it floats. It could, for instance, make an issue at 2 per cent instead of the figure of 4 or 4¼ per cent which has been usual hitherto. Whether the money would be forthcoming from the investing public is, of course, quite another matter.

Tredegar, Mon. JOHN PUGH, A.M.I.E.E.

REFERRING to " Cathay's " letter in your issue of 25th December, while I agree that a figure of 7s 6d as representing " legislation " charges for the collection of a quarterly account for £2 is high, " Cathay's " suggestion that 1s 7d per annum is the most that can be assigned to this item is much too low. If he recasts the costs involved I think he will agree that the total annual amount attributable to legislation works out at something over 10s per consumer.

With regard to the suggestion made by a speaker in the I.E.E. discussion on " The Influence of Legislation on the Costs of Metering " on 1st December last, one recalls many instances in the old days when consumers were connected up by supply companies without meters being installed. Accounts on an estimated consumption basis were rendered until such time as meters were available and on the whole the system worked with surprisingly few complaints.

" RAYCATH."

Echoes of the Past

I THINK there must be few electrical engineers alive at the present time whose memories of the early days of electrical engineering can go farther back than mine. I am now eighty-eight and my interest in electrical work began when I was fourteen. It was about 1880 when Cheapside and the Royal Exchange were first lit up with arc lamps and I well remember one supposed to be of 250,000 candle-power.

I was under the well-known professors Ayrton, Perry and Silvanus P. Thompson at the Finsbury Technical College from 1883 to 1887. In the latter year I joined the Elieson Electric Co. at Homerton whose speciality was accumulators made of lead strip formed into spirals with asbestos paper between the spirals and these were plugged and clamped into cast lead plates specially shaped to take them. They were then charged and reversed several times till the lead oxide and spongy lead were sufficiently formed to make into accumulators. These were then used for the driving of electric trams from Stratford Church to Manor Park, London. A regular service of these was running in 1887.

It was about this time that I joined the firm of Immisch & Co. of Kentish Town and they took up the making of electric launches at Kew Bridge with a Mr. Sargeant as manager and ran a service of launches under the old firm of Woodhouse & Rawson.

While with Immisch & Co. I had several years of mining work, fitting up pumping, hauling and winding plants in England, Scotland and Wales. I was recommended by Dr. S. P. Thompson for the post of electrical engineer to the City of South London Railway, but owing to a hand injury did not apply for it. I entered Siemens Bros. & Co. in 1892 and remained with them thirty-seven years, mainly engaged on estimating work.

There are few branches of electrical work in which I have not had experience of some kind, but in the space available to me it would be impossible to set down more than I have.

London, N.7. W. J. ORMSTON.

I.E.E. LENDING LIBRARY

WE are asked to draw the attention of members of the Institution of Electrical Engineers to the catalogue of the lending library of the Institution, published in 1950, which lists all books acquired to the end of 1949 and to a supplement listing all books obtained during the years 1950–1952. The librarian is prepared to recommend books or provide a list of those relevant to a particular inquiry, but it is to the advantage of any member making use of the library facilities to have a copy of the catalogue, which contains subject as well as author entries. The catalogue and supplement is priced at 2s post free.

I.E.E. LONDON MEETINGS

Arrangements for Second Half of Session

THE programme for the second half of the 1953–54 Session of the Institution of Electrical Engineers is a very full one and for the convenience of our readers we have grouped the meetings under their respective headings. In addition to the meetings listed below members may wish to note the following important events:—

The Faraday Lecture by Mr. O. W. Humphreys on "Electro-Heat and Prosperity," to be given on 16th February at the Central Hall, Westminster; Institution annual dinner on 25th February at Grosvenor House, Park Lane; joint dinner-dance of the Radio and Measurements Sections on 31st March at the Café Royal; Supply Section dinner-dance on 8th April at the Café Royal; Kelvin Lecture by Mr. J. A. Ratcliffe on "The Physics of the Ionosphere" on 29th April at the Institution; the annual general meeting of the Institution on 20th May; joint meeting with the Institution of Civil Engineers at Great George Street, S.W.1, on 25th May when a paper by Messrs. C. R. Westlake, T. A. L. Paton and R. W. Mountain will be given on "The Owen Falls, Uganda, Hydro-Electrical Development—General Aspects"; and the Institution summer meeting to be held in the Western Centre from 29th June to 2nd July.

Ordinary Meetings

4th February: "The Manchester–Kirk o'Shotts Television Radio Relay System," by G. Dawson, L. L. Hall, K. G. Hodgson, R. A. Meers and J. H. H. Merriman (Radio Section paper). 4th March: "Submerged Telephone Repeaters for Shallow Water," by R. J. Halsey and F. C. Wright. "The Netherlands–Denmark Submerged-Repeater System," by A. H. Roche and F. O. Roe. "British Post Office Standard Submerged Repeater System for Shallow-Water Cables, with special mention of the England–Netherlands System," by D. C. Walker and J. F. P. Thomas. 25th March: "The Kemano Hydro-Electric Development and Associated Kitimat Aluminium-Reduction Works," by F. L. Lawton (Supply Section paper). 1st April: "The Possibilities of a Cross-Channel Power Link," by D. P. Sayers, M. E. Laborde and F. J. Lane. 6th May: "Electric Traction Using Single-Phase 50 c/s Current," by M. Garreau. "Electric Locomotives on the Valenciennes–Thionville Line," by F. Nouvion. 27th May: "Development and Utilization of Hydro-Electric Power in Uganda," by J. M. Stock and J. C. Lithgow (Supply Section paper).

Informal Meetings

8th February: Discussion on "Will it be possible to Abolish Meters Entirely?" opened by H. S. Petch and M. Whitehead. 8th March: Discussion on "How can Electrical Methods Enhance Industrial Productivity," opened by Sir Henry Clay, Bt. 12th April: Discussion on "Safety Measures for Radio and Television Equipment," opened by E. P. Wethey.

Education Discussion Circle

15th February: Discussion on "The Teaching of the Subject of Insulating Materials," opened by Dr. Willis Jackson. 23rd March: Demonstration Lecture, "An Experimental and Theoretical Approach to the Teaching of Electromagnetism using the Rationalized M.K.S. System of Units," by F. A. Meier. 23rd April: Discussion on "A Method for the Plotting of Magnetic Fields due to Currents," opened by Dr. F. T. Chapman and D. G. Sandeman. 18th May: "Questions Night." 18th June: Exhibition of Apparatus. (To be held at the Battersea Polytechnic.)

Radio Section

25th January: Discussion on "Should Sound Broadcasting of the Future be Entirely in the V.H.F. Band?" opened by Dr. A. J. Biggs. 10th February: "Basic Ground-Wave Propagation Characteristics in the 50–800 Mc/s Band," by Dr. J. A. Saxton. "Ground-Wave Field Strength Surveys at 100 and 600 Mc/s," by Dr. J. A. Saxton and B. N. Harden. 22nd February: Discussion on "Acceptable Standards of Quality in Sound Broadcast Transmission and Reception," opened by J. K. Webb. 10th March: "A Study of Some of the Properties of Matter Affecting Valve Reliability," by Dr. E. A. O'Donnell Roberts. 22nd March: "Colour Television," by C. J. Hirsch. 5th April: Discussion on "Technical Problems involved in Receiving Alternative Television Programmes," 26th April: "The Experimental Synthesis of Speech," by W. Lawrence. 5th May: "The Reflection and Absorption of Radio Waves in the Ionosphere," by W. R. Piggott. "Some Notes on the Absorption of Radio Waves Reflected from the Ionosphere at Oblique Incidence," by Dr. W. J. Beynon.

Measurements Section

2nd March: "Current and Power Relationships in the Measurement of Iron Losses in a Three-Limbed Transformer Core," by Prof. F. Brailsford. "An Automatic Plotter for Magnetic Hysteresis Loops," by H. McG. Ross. 16th March: "The Minimum-Moment-of-Error-Squared Criterion: a New Performance Criterion for Servo Mechanisms," by Dr. J. H. Westcott. "The Behaviour of a Remote Position Control Servo Mechanism with Hard-Spring Non-Linear Characteristics," by Dr. J. C. West and P. N. Nikiforuk. 6th April: "Determination of the Static and Dynamic Elastic Properties of Resilient Materials," by R. S. Jackson, Dr. A. J. King and C. R. Maguire. "A Method of Using Microwaves for Measuring Small Displacements and a Torque Meter Using this Principle," by N. C. de V. Enslin (to be read by Prof. R. Guelke). "Magnetic Measurement of Mechanical Hardness," by D. Hadfield. 27th April: "Auto-Self-Excited Transductors and Push-Pull Circuit Theory," by A. G. Milnes and T. S. Law. "Composite Cores for Instrument Transductors," by Dr. E. H. Frost-Smith and A. E. De Barr. 11th May: "Measurement as a Factor in Understanding," by Dr. K. J. R. Wilkinson. 11th June: Section Summer Visit.

Supply Section

27th January: "Service Experience of the Effect of Corrosion on Steel-Cored Aluminium Overhead-Line Conductors," by Dr. J. S. Forrest and J. M. Ward. 24th February: "The Transport, Preparation and Utilization of Colliery Tailings at the Emile Huchet Power Station," by Prof. R. Gibrat and F. Chenin. (Joint meeting with the British Section of the Société Ingénieurs Civils de France.) 24th March: "Cathode-Spot Performance Phases and Control of Mass Transfer in Vapour-Discharge Devices," by Dr. H. Von Bertele. 28th April: "Aluminium Sheathed Cables," by P. M. Hollingsworth and P. A. Raine. 1st May: Visit to the Atomic Energy Research Establishment, Harwell. 26th May: Annual Lecture. September: Section Summer Visit.

Utilization Section

18th February: "Electronic Motor Control," by A. O. Dalton. "Arc-Quenching Circuits," by B. H. Stonehouse. "A Survey of the Principles of the Contact Rectifier," by D. R. Smith. 18th March: Discussion on "The Training and Responsibilities of Marine Electrical Engineers," opened by G. O. Watson. 22nd April: "Safety in the Use of Portable and Transportable Electrical Equipment in Industry," by J. Bunting. 13th May: "Fuel Supplies of the Future," by E. F. Schumacher. 28th–29th May: Section Summer Visit.

Joint Meetings

Measurements and Supply Sections. 2nd February: "Measurement of the Winding Resistances of a 132 kV Power Transformer in Service," by Dr. K. J. R. Wilkinson and J. D. Harmer. 23rd February: "Some Applications of the Electrolytic Tank to Engineering Design Problems," by H. Diggle and E. R. Hartill. Radio and Measurements Sections. 7th April: "A Versatile Transistor Circuit," by E. H. Cooke-Yarborough. "The Measurement of the Small-Signal Characteristics of Transistors," by E. H. Cooke-Yarborough, C. D. Florid and Dr. J. H. Stephen. "A Bridge for Measuring the a.c. Parameters of Type 'A' Transistors," by Dr. A. R. Boothroyd and L. K. Datta. "The Transistor as a Regenerative Amplifier with some Application to Computing Circuits," by G. B. B. Chaplin.

Extra Meetings

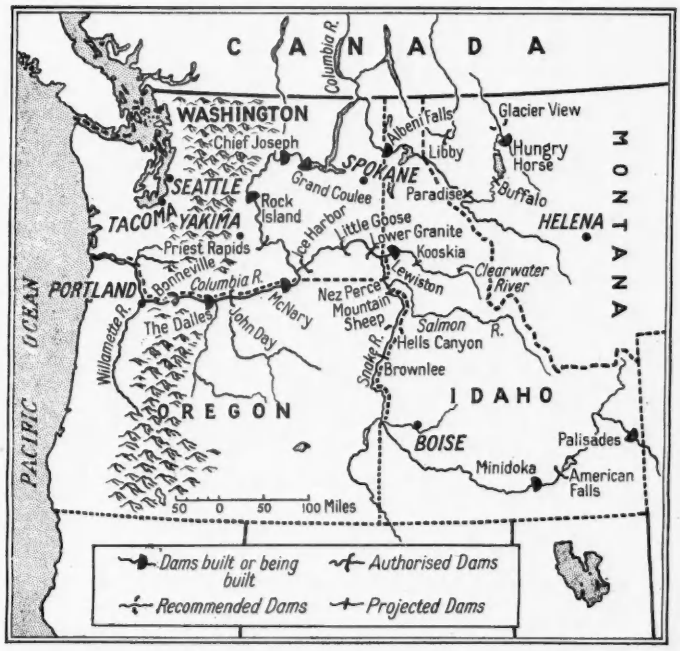
11th February: "A Short Modern Review of Fundamental Electromagnetic Theory," by P. Hammond. 11th March: "An 8 MeV Linear Accelerator for X-Ray Therapy," by C. W. Miller.

Leading British electrical manufacturers have been actively striving for contracts in connection with the harnessing of the Columbia River in the North Western United States. This article, which appeared in the ***Economist*** of 9th January, is consequently of interest to many of our readers and the Editor has kindly given us permission to reproduce it

Damming Up the Northwest

FROM A CORRESPONDENT RECENTLY IN OREGON

IN the Pacific Northwest President Eisenhower's "indispensable ingredient" of sound planning and aggressive enterprise, "a persistent and reasoned faith in the growth and progress of America," has for some time been running head-on into another of his principles, his determination to decentralise government by handing over as much as possible to local and private agencies. This determination led last August to the Administration's new policy on the development and distribution of hydro-electricity, which put the primary responsibility for supplying power on to local communities and private companies. But the economy of the four northwestern states, especially of Washington and Oregon, has expanded in the last thirteen years at a rate far above the national average, almost entirely as a result of the cheap power made available by the government's dams on the Columbia River and its tributaries. These are still by far the greatest undeveloped source of hydro-electricity in the country; potential capacity is put at over 30 million kilowatts, and less than a quarter of this has been harnessed so far. To the Northwest the federal government's apparent intention of withdrawing from further power development looked like a threat to dam up the region's growth.



From map prepared by U.S. Army Corps of Engineers. Many smaller federal, state and private projects not shown

The threat is to the area's agricultural as well as to its industrial expansion, for the huge federal multi-purpose dams provide not only the power which has attracted industry to the Northwest but the water that makes it possible to cultivate the parched inland plateau. As a result both trade unions and farm organisations are deeply concerned at the implications of the government's new policy, as indeed is almost everyone else in the region. The Democrats are naturally doing their best to spread this concern as widely as possible and to crystallise it into anti-Republican votes next November. The catalyst they are using is the controversy over whether the development of one of the most important dam sites in the Columbia Basin, Hells Canyon, should wait until the federal government can undertake it, or should be carried out sooner, but less satisfactorily, by a private company.

Such an issue, which can be used to point up how the long-term interests of the area may suffer if the federal government is allowed to bow out, is vital to the Democrats because next November comes too soon for the government's withdrawal—and it has not yet said that it will withdraw entirely—to have had any harmful effect on industrial employment or farm production. There is still irrigating capacity unused, particularly from the Grand Coulee development, and during the next few years various hydro-electric projects now under construction, such as The Dalles, the Chief Joseph and the McNary dams, will be coming into production. Unless there is an unusually severe drought, this should be enough to prevent a repetition of last winter's power shortage for some time.

But already the Bonneville Power Administration, which distributes the electricity generated from the federal dams and provides some 60 per cent of the power used in the area, is unable to take on new electro-process consumers, such as aluminium companies, which want large blocks of power. New industries are especially needed in the State of Washington, which is overdependent for its employment on the government—on defence contracts at the Boeing aircraft factory and the navy's shipyards in and near Seattle and on the atomic energy installations at Hanford. Even normal growth of existing industries, and of population (from 4·7 million in 1950 to about 5·7 million in 1960), make a power shortage inevitable in the Northwest by, or soon after, 1960, unless additional capacity is installed.

The annual energy requirements of the region increased from 7 billion kilowatt hours in 1940 to about 40 billion last year; the Bonneville Power Administration estimates that they may reach double that amount, about 80 billion,

by 1960, and that by then 750,000 kilowatts of new capacity will be needed a year. These estimates are, of course, based on the supposition that there will be no lasting economic recession, either nationally or locally—but in the booming Northwest, even more than in the rest of America, it would be heresy to suppose anything else.

* * * *

A recession would not only reduce the demand for electricity, but also make it more likely that the necessary new dams would be built by the federal government, as pump-priming public works. For the impending shortage is the result not of bad planning, but of Congress's refusal to provide money to implement the plans. An integrated programme was worked out in the nineteen-thirties, and has been brought up to date since, for the orderly development of the region's resources and for the building of dams to a schedule that would have kept supply in step with demand. But since 1946, when the wartime need for extra electricity was over, the programme has been suffering from creeping paralysis, until now there are no new projects even under Congressional consideration; several that have been authorised, the series on the Snake River above the McNary dam for example, have not been begun and those under construction have been delayed.

This is not the fault of the present Administration; post-war Democratic Congresses showed little enthusiasm for such schemes and not even President Truman pressed them very hard. But the Republicans came to office just as the delay became disastrous. For these big dams take at least five years and probably longer to plan and build and they must be begun at once if electricity is to come from them by 1960.

Even if President Eisenhower were to press for funds for some of the authorised dams, Congress would probably not give him the money. For the desire to economise on federal spending, stronger than ever this year, is by no means the only obstacle. Representatives from rich eastern industrial districts and from poor southern agricultural ones agree in failing to see why their constituents' taxes should subsidise competition from a region that is already doing better than the rest of the nation. They are therefore very ready to listen to the protests of the private power companies' lobbyists and of the other local spokesmen who oppose the big federal dams.

The strongest objections come from fishermen—not only from the commercial companies but from the sportsmen. One out of every five Oregonians has a fishing licence and that means too many votes for any northwestern politician to ignore. The Army Engineers, who are responsible for recommending dam sites, chose Hells Canyon rather than Nez Perce, said to be as satisfactory otherwise, because the latter would have kept the salmon from their spawning grounds in the Salmon River. Similarly a potential dam site at Kooskia is not being considered because it would interfere with Indian interests: another nearly extinct survival of early America, the elk, would have its traditional feeding grounds flooded by a dam at Glacier Park. The Libby dam has been held up because its lake would spread over the Canadian border and international negotiations are necessary.

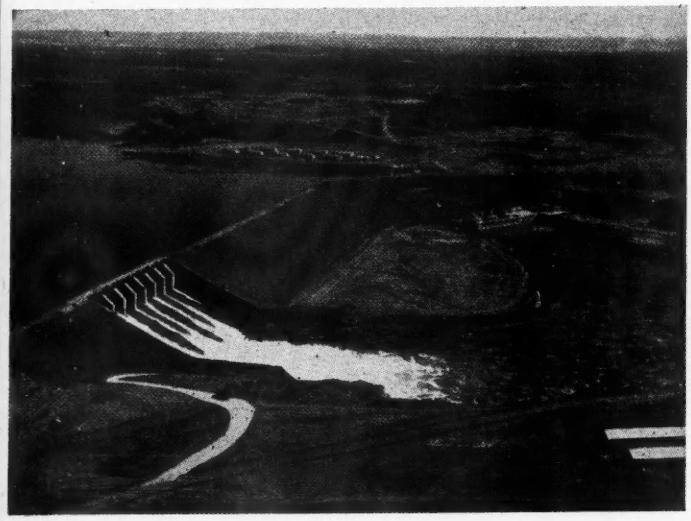
These enormous upstream dams, of which only Grand Coulee and Hungry Horse have been built, are storage dams, where water can be held to supplement the flow through run-of-the-river dams at Bonneville and elsewhere during the autumn and winter. The Columbia and its tributaries are fed by melting snow and when the level of the water is low the downstream generators cannot work to capacity. Thus the full potentialities of existing dams cannot be relied on all the year round unless more storage dams are built. This is the basis of the argument against the taking over of the Hells Canyon site by a private company. The three small dams which this company proposes to build would have a much smaller storage capacity, although only a slightly smaller installed capacity, than the big federal dam. But if permits are granted soon, they could be in operation well before 1960, while the federal dam is not even authorised yet.

* * * *

This Hells Canyon project is only one example of the spurt of dam-building activity among private companies and local public power authorities (plentiful in the State of Washington) who are trying to show that they can beat the shortage now that the federal government is ready to let them. They have always argued that there would never have been a power shortage in the Northwest at all if federal interference had not made it impossible for private companies to plan an orderly commercial development.

Until now, nevertheless, the private and local public companies have never proposed building the much-needed multi-purpose dams, presumably because their cost, from a quarter to half a billion dollars, was too great. Even the present Secretary of the Interior admits that these are still the responsibility of the federal government, for the purposes for which they exist officially, improved navigation, flood control and irrigation, are " non-reimbursable," that is, unprofitable. The latest suggestion, however, which the six leading companies in the Northwest are now thinking of carrying out jointly, is that such dams might be built in partnership with the federal government, with the private companies being responsible for the profitable side of the undertaking, the generation of electricity. This partnership idea has the support of the region's four State Governors, and apparently also of the Secretary of the Interior; they are prepared to press for federal legislation, if necessary, to implement it. But even if enough money is found in this way to overcome the immediately impending crisis, it would not be an answer to the question of who, if not the federal government, is going to do the long-term planning, without which the full possibilities of the Columbia Basin cannot be realised.

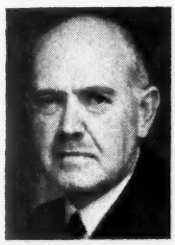
One of the latest developments of the Idaho Power Co. on the Snake River: the 82,500 kW C. J. Strike plant



PERSONAL AND SOCIAL

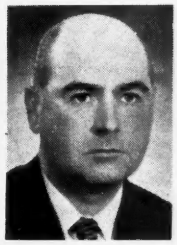
News of Men and Women of the Industry

THREE new senior appointments have been announced by Johnson & Phillips, Ltd., in connection with the reorganization of the company's sales administration. The appointments took effect on 1st January. **Mr. B. E. Leeson,** who before joining J. & P. in 1950 as senior sales engineer (switchgear), was sales manager with Switchgear &



Mr. B. E. Leeson

Mr. C. W. Cawte



Mr. D. S. Barwell

Cowans, Ltd., becomes home sales manager (plant), and will be responsible for switchgear, transformer and capacitor sales. In his new capacity Mr. Leeson will continue to operate from the company's Manchester office.

Mr. C. W. Cawte, B.Sc.(Eng.), A.M.I.E.E., who has been manager of the Cable Estimating Department since 1942 and has represented the company on C.M.A. matters for many years, has been appointed home sales manager (cables), and **Mr. D. S. Barwell** joins the export manager, Mr. F. C. Morris, as sales promotion manager (export). Mr. Barwell has recently returned to this country after an extensive tour of Latin America on behalf of the company.

We learn from Mr. W. K. Allen, M.Eng., A.M.I.E.E., A.M.I.Mech.E., managing director of the Jersey Electricity Co., Ltd., that **Mr. L. J. Hawkley,** A.M.I.E.E., of the Midlands Electricity Board, has been appointed sales and contracts engineer to the company and took up his duties on 19th January. Mr. Hawkley, who has been commercial engineer to the Sutton Coldfield District since 1950, previously held appointments in the Commercial Department of the City of Birmingham Electric Supply Department. He served with the R.A.F. from 1940 to 1946.

Mr. A. N. Brighton, B.Sc., A.M.I.E.E., A.M.I.Mech.E., has been appointed technical assistant to the company as from 15th January. He has held appointments in the Transmission Department of the Uganda Electricity Board since February, 1951, and was previously with the Southern Rhodesia Electricity Supply Commission for four years. Before that, he was with Messrs. Preece, Cardew and Rider, the Air Ministry Works Directorate and Edmundsons Electricity Corporation, Ltd.

The B.B.C. announces the appointment of **Mr. H. O. Sampson** as head of technical operations, television studios. Mr. Sampson joined the B.B.C. television service at Alexandra Palace in 1936 and remained there until the service was suspended at the outbreak of war. During the war he served at several of the B.B.C.'s high power transmitting stations and with the London Recording Unit. Early in 1944 he joined the War Reporting Unit as an engineer-correspondent. Mr. Sampson returned to the television service in 1946 as senior lighting engineer. He became assistant head of technical operations, television studios, in 1952.

Mr. W. R. Warren, youth training assistant at the North Western Division headquarters, British Electricity Authority, has been appointed education and training officer, Midlands Division, B.E.A. He takes up his new appointment on 1st February.

In our last issue we briefly reported the appointments of **Mr. J. E. Sunderland,** A.C.A., as director and general manager of Enfield Cables, Ltd., and **Mr. M. J. Smith,** O.B.E., B.Sc.(Eng.), D.F.H.(Hons.), A.M.I.E.E., as technical director.

Mr. Sunderland joined the company in 1946 and has been a member of the Board since 1951. He was previously with J. Samuel White & Co., Ltd., shipbuilders, of Cowes.

Mr. J. E. Sunderland

Mr. M. J. Smith

Mr. Smith was formerly with the British Electricity Authority. His war service comprised flying duties with the R.A.F.V.R., until 1941. Following a flying accident he became chief electrical engineer to R.A.F. Bomber Command and subsequently, after demobilization, electrical development engineer to the Copper Development Association. He joined the B.E.A. in 1950 as chief overhead line design engineer and more recently was promoted to the position of power circuits engineer.

Mr. W. G. Thomas, M.Inst.F., has been elected a director of Radiovisor Parent, Ltd. He is also managing director of Bailey Meters & Controls, Ltd., and chairman of the British Industrial Measuring & Control Apparatus Manufacturers' Association.

Mr. W. B. Whitney, Ph.D., B.Sc., M.I.C.E., M.I.E.E., retired from the Electrical Research Association at the end of 1953 but is continuing his

Dr. W. B. Whitney

connection in a part-time capacity. He joined the E.R.A. in 1920 and built up the Switch- and Control-Gear Department, of which he has been in charge until now. In 1950 he added the duties of assistant director to his other responsibilities. As an engineer his reputation is particularly associated with the invention, with Mr. E. B. Wedmore, of the gas-blast and side-blast oil baffle type circuit breakers—principles which still form the basis of the majority of high-power switchgear throughout the world. Nevertheless it is true to say that, having conceived important ideas, he spent most of his time in endeavouring to secure their scientific explanation and the basic principles on which development should be founded. It is for this that members of the Electrical Research Association have had the more direct reasons for appreciating his work.

Dr. Whitney's retirement will entail certain changes in the E.R.A. organization. Mr. L. Gosland's Department

(Transmission and Utilization) has been reorganized and will now include the switchgear researches. He will have the assistance of **Dr. C. E. R. Bruce** and **Mr. A. M. Cassie,** whose work on the physical principles of switchgear is well-known. **Dr. G. Mole** and **Dr. L. H. Orton** will deputize for him on certain subjects.

Mr. W. Nethercot has been appointed head of the Department of Ignition and Radio Interference.

The new chairman of the East Midlands Branch of the Institution of Mechanical Engineers is **Mr. J. H. R. Nixon,** M.I.Mech.E., M.I.E.E., technical director of the Brush Electrical Engineering Co., Ltd. Mr. Nixon's educational interests include life membership of Court of the University of Nottingham and he is a member of the University Engineering Advisory Committee. He is also a governor of the Loughborough Colleges under the Leicestershire Educational Authority, a member of the Engineering Advisory Committee of the Loughborough

Mr. J. H. R. Nixon

College of Further Education, and a member of the Education Committee of the British Electrical and Allied Manufacturers' Association.

He takes a keen interest in industrial administration and management and is a Fellow of the Institute of Industrial Administration, a founder member of the British Institute of Management and a Fellow of the Royal Economic Society. Mr. Nixon was chairman East Midland Sub-Centre (now raised to the status of a Centre), of the I.E.E. for 1933–34.

Ald. W. S. Lewis, a former Lord Mayor of Birmingham, and the present chairman of the Midlands Electricity Board, is to resign from the City Council of which he has been a member for twenty-seven years. He said he had made the decision because of his recent appointment to the British Electricity Authority. He would probably resign in March so that his seat could be filled in the May elections.

The following appointments in Hoover sales/service organization are announced: **Mr. W. A. Driver,** South London branch manager; **Mr. G. D. Clancy,** Northern branch manager; **Mr. F. W. O'Loughlin,** district manager, Leicester; **Mr. W. W. Arnold,** district manager, Newcastle; **Mr. A. Hutchison,** district manager, Birmingham; **Mr. P. J. Trotman,** special managerial duties in the contract department; **Mr. G. Hanson,** district manager, Glasgow North; **Mr. R. B. Carpenter,** district manager, Leeds; **Mr. A. H. Cockwell,** district manager, Kingston; **Mr. W. R. Walters,** district manager, Sutton; **Mr. W. M. Thompson,** district manager, Westminster; **Mr. I. K. S. Joll,** sales manager, Contract Department; **Mr. H. F. McColl,** district manager, Cheltenham; and **Mr. J. Hanby,** district manager, Portsmouth.

We regret that we omitted from the list of New Year Honours in our issue of 8th January the name of **Rear-Admiral (L) C. P. Clarke,** C.B., D.S.O., R.N. (Retired), M.I.E.E., Director of the Naval Electrical Branch, Admiralty, who was created a K.B.E.

Mr. W. F. Randall, B.Sc.(Eng.), A.R.S.M., M.I.E.E., F.I.M., a director of the Telegraph Construction & Maintenance Co., Ltd., leaves London on 30th January for a two months' visit to the company's branches and representatives in Karachi, Bombay, Singapore, Australia and New Zealand, including a visit to the company's Selborne Plantation in Malaya.

Mr. E. A. T. Farrant has been appointed secretary of the Telephone Manufacturing Co., Ltd., in succession to **Mr. G. H. Field,** who has retired.

In our last issue we referred to the retirement of Mr. H. Faulkner from the position of deputy engineer-in-chief of the General Post Office, and his appointment as director of the Telecommunication Engineering and Manufacturing Association. Mr. Faulkner has been succeeded as deputy engineer-in-chief, G.P.O., by **Mr. A. H. Mumford,** O.B.E., B.Sc.(Eng.), M.I.E.E., who has been assistant engineer-in-chief since 1951. Mr. Mumford was born in London in 1903 and was educated at Bancroft's School and Queen Mary College (London University). He joined the G.P.O. in 1924 as assistant engineer, Radio Branch,

Mr. A. H. Mumford

Engineer-in-Chief's Office. He was appointed executive engineer in charge of the radio laboratory at Dollis Hill in 1933, being promoted to assistant staff engineer two years later. He became staff engineer in charge of the Radio Development Branch in 1938. Mr. Mumford was chairman of the Radio Section of the I.E.E. for 1945–46.

W. T. Henley's Telegraph Works Co., Ltd., has announced the following appointments which take effect as from 1st January. **Mr. R. B. Hill** is appointed manager, Cable Sales Department, **Mr. W. M. Baxter,** who was

Mr. R. B. Hill

Mr. W. M. Baxter

Mr. N. B. Frost

formerly manager of the Export Sales Department, becomes chief assistant manager, Cable Sales Department, and he is succeeded by **Mr. N. B. Frost** as manager of the Export Cable Sales Division.

Mr. Leslie Gamage, M.C., vice-chairman and joint managing director of the General Electric Co., Ltd., left London Airport on Monday last for a business visit to Malaya and Hong Kong. He was accompanied by his wife, the Hon. Mrs. Leslie Gamage, and they were due to arrive in Singapore yesterday (Thursday). During a month in S.E. Asia they will visit the company's branches in Hong Kong, Singapore, Kuala Lumpur, Malacca and Penang; they also intend to visit Ipoh. They will return from Singapore by air on 23rd February.

Mr. R. C. Pennington, lately chief lighting engineer with the Courtaulds group, has joined Harris & Sheldon (Electrical), Ltd., lighting specialists.

Newton, Chambers & Co., Ltd., have appointed three new assistant managing directors, each with special responsibilities. They are **Mr. P. J. C. Bovil** (Chemicals Branch), **Mr. S. C. Tyrell** (Excavator Branch), and **Mr. K. E. Walker** (Engineering Branch, including the Heavy Constructional Department and the Light Castings Department).

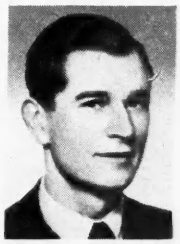
Mr. A. B. Wilkinson, M.I.E.E., M.I.Min.E., at present head of the Department of Mining and Fuels in the Municipal College, Burnley, has been appointed head of the Mining Department of the Nottingham and District Technical College.

Mr. F. Howitt has relinquished the position of technical superintendent and deputy manager of the Northern Aluminium Co.'s Birmingham works on being transferred to a sister company, Aluminum Company of Canada Ltd., Montreal. **Mr. S. Wilding** has

been appointed production manager, being succeeded as works engineer by **Mr. D. A. Ellis. Mr. A. R. Martin** assumes the full responsibilities of chief metallurgist.

The annual dinner of the **Wholesale Fittings Co., Ltd.,** was held on 9th January at the Tavistock Restaurant, Charing Cross Road, W.C.2. The occasion was especially noteworthy as it commemorated the diamond jubilee of the company. Speeches were made by Mr. J. Altman (chairman), Mr. W. Posner (manager of the Dean Street Branch) and Mr. F. C. Barnett (managing director), the last-mentioned referring to the establishment of another branch at Ilford and the extension of the premises at Manchester and Bristol. The dinner was followed by a dance.

Mr. C. Gillott, sales manager of Gillott Electro Appliances, Ltd., of Chalford, Glos., has been appointed sales manager of New Day Electrical Accessories, Ltd. Mr. Gillott will manage the sales of both companies, which are subsidiaries of Southern Areas Electric Corporation, Ltd., from the New Day company's works at Mary Street, Balsall Heath, Birmingham.



Mr. C. Gillott

The National Gas and Oil Engine Co., Ltd., announces the following appointments in the sales organization: **Mr. F. D. Langley** becomes sales manager, and **Mr. W. L. Beckett** becomes London area sales manager, both with offices at Duke's Court, 32, Duke Street, St. James's, S.W.1. Mr. Langley has also been appointed director of National Oil Engines (Export), Ltd. **Mr. J. A. Barker** becomes commercial manager at head office, Wellington Works, Ashton-under-Lyne, in charge of the Commercial Department.

Mr. B. A. Robinson, M.I.E.E., M.I.Mech.E., who has been with the Cambridge Instrument Co., Ltd., for forty-one years, and has been its district representative for thirty-two years in the Newcastle-on-Tyne area, has retired. He is succeeded as district representative by his son, **Mr. W. E. Robinson.**

Mr. F. C. Burstall has been appointed deputy managing director of the Automatic Telephone & Electric Co., Ltd.

Mr. R. Owen, Associate I.E.E., has been appointed sales manager to the Mersey Cable Works, Ltd. He was previously area engineer, Central England, for the Pirelli-General Cable Works, Ltd.

Before the meeting of the Southern Electricity Consultative Council at Reading on 12th January the chairman, G/Capt. J. C. M. Hay, O.B.E., on behalf of the members, presented an electric clock to **Mr. A. Lockwood,** who was chairman of the Council from 1950 until last September.

Mr. P. Bell, M.S.I.A., has joined Allom Brothers, Ltd., as design consultant for tungsten fittings. The company is extending its activities to meet the growing demand for special lighting schemes and contemporary fittings.

Mr. Frank Linley, M.I.E.E., purchasing officer to the North Western Electricity Board, has been appointed manager of the Board's No. 1 Sub-Area, based at Manchester, in succession to **Mr. H. G. Bell,** who was recently appointed chief engineer to the Board. Mr. Linley, who takes up his new duties on 1st February, was mains engineer for No. 1 Sub-Area before being appointed purchasing officer to the Board in July last year. He joined the former Manchester Corporation Electricity Department in 1923 after experience with the Armstrong Whitworth and Crossley Motor Companies. At Manchester he held various positions before being appointed chief assistant mains engineer in 1944, becoming mains engineer of the Sub-Area on nationalization.

Mr. F. Linley

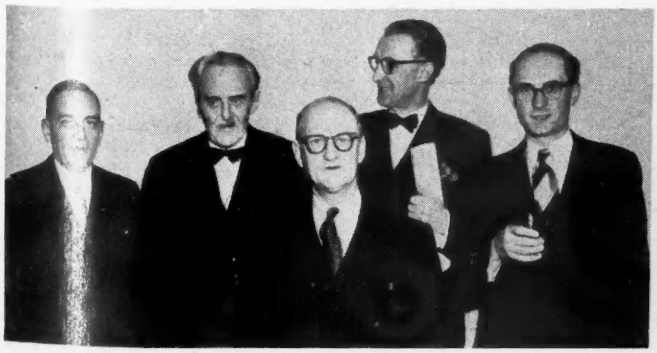
Mr. E. G. Swangren

Mr. E. G. Swangren, M.I.E.E., has been appointed head of the operation and maintenance section of the Chief Engineer's Department of the North Eastern Electricity Board with effect from 1st February, in succession to **Mr. H. Esther,** who, as we have already reported, has been appointed chief engineer. Mr. Swangren joined the North-Eastern Electric Supply Co., Ltd., in 1914, and after service in power stations and in various sections of that company, was appointed chief control engineer in 1938. He later became superintendent, Northern Area, and at vesting date was appointed sub-area engineer for the Wear Sub-Area of the North Eastern Board. He has served on the Committee of the North Eastern Centre of the I.E.E.

The following executive staff changes, effective from 1st January, are announced by Bakelite, Ltd.:— **Mr. A. Lloyd,** previously joint manager, Thermosetting Division, and works manager at Tyseley, has been appointed general works manager; **Mr. G. J. Taylor,** joint manager and sales manager of the Thermosetting Division, becomes manager of

At last week's luncheon of the Electrical Industries Club

Left to right: Messrs. R. Baldwin (vice-chairman), A. B. Wildsmith (chairman), W. E. Babb (hon. secretary), H. Senior Fothergill (hon. treasurer) H. F. Wickham, (hon. social secretary) and Sir Henry Self, Sir John Hacking and Mr. H. S. Pocock



the Thermosetting Division; **Mr. P. Smith,** sales manager, laminated materials, is now sales manager, Thermosetting Division; **Mr. C. E. Tofts,** assistant to Mr. P. Smith, is appointed sales manager, laminated materials; **Mr. R. Hulse,** manager, moulding material production at Tyseley becomes works manager, Tyseley; and **Mr. A. Tonks,** Works Technical Department is manager, moulding material production at Tyseley.

Many readers will learn with regret that **Mr. Philip G. Wallis,** Associate I.E.E., has decided to relinquish his control of the electrical contracting and retailing activities of G. E. Wallis & Sons (Electrical), Ltd., Maidstone, after nearly thirty years in this position, on account of eye trouble. He will, however, remain a director and will act as electrical consultant to the company and its parent concern, G. E. Wallis & Sons, Ltd. Mr. Wallis has been active in the affairs of the Electrical Contractors' Association for many years. He has been hon. secretary of the Maidstone Branch since 1932 and was president of the E.C.A. in 1950–51. As "Pilgrim Three" he has been a regular and lively contributor to the Association's journal for a long time. Apart from this, he has been president of the Maidstone Model Engineers' Society since 1949 and is actively interested in the local Rotary Club.

The need for increased membership of the **Electrical Industries Benevolent Association** was stressed by Sir John Dalton, national president, at the annual dinner of the Nottingham Branch on 9th January. In saying that subscriptions from actual members represented only a small part of the association's income, Sir John appealed to the branch to make a drive for more members in order to give the association an assured income. Mr. G. C. Russell (Branch chairman) congratulated past-president and committee member Mr. C. R. King (chairman of the East Midlands Electricity Board since 1948) on his award in the New Year Honours of the C.B.E. for services rendered to the industry.

Two employees of the **Micanite & Insulators Co., Ltd.,** London, E.17, have recently completed fifty years' continuous service with the company. They are Miss Harriet Fletcher, who commenced with the company in May, 1903, retiring on 31st December, 1953, and Mr. Arthur Bull, who commenced on 1st January, 1904, and who is still actively engaged as a foreman.

The Ekco annual children's party was held at the Southend works of **E. K. Cole, Ltd.,** on 9th January. Nearly 700 children attended and were entertained to tea, followed by a film show which was presented by the British-Victor staff of E. K. Cole, Ltd.'s London office.

The second annual dinner of the MKB Birmingham works "25 Club" of **McKechnie Bros., Ltd.,** was held at the Imperial Hotel, Birmingham, on 8th January Mr. H. Hollingworth, president, presiding. Watches or clocks were presented to ten employees with twenty-five years' service with the company. The Club membership is now 195. Mr. J. D. McKechnie, chairman and managing director, was unable to attend but he sent a message.

Mr. W. J. Howard, who was for many years in charge of the distribution side of the Sheffield Corporation electricity undertaking, and whose name is associated with leakage-to-frame (Howard earth leakage) protection, celebrated his 80th birthday on Christmas Day. To mark the occasion a group of old friends and colleagues entertained him to dinner in Sheffield on 14th January.

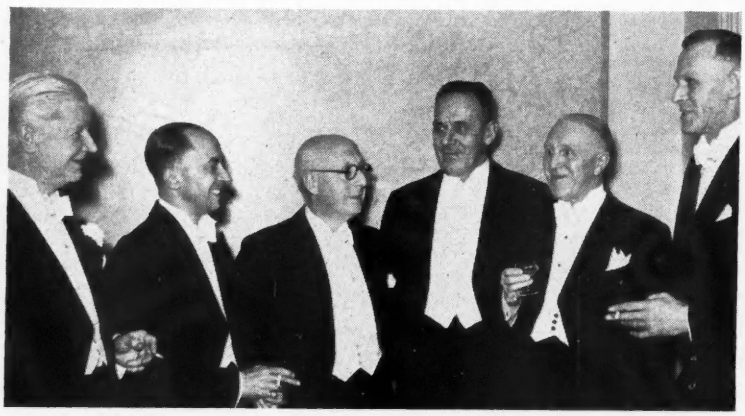
The Manchester Branch Social Club of the **Reliance Telephone Co., Ltd.,** held its annual dinner-dance and social at the Grosvenor Hotel, Manchester, on 9th January. The chairman for the evening was Mr. A. Bailey, branch manager, and the chief guest was Mr. E. G. Taylor of the G.E.C. About 120 people were present.

About 750 children of employees of the **Telegraph Construction & Maintenance Co., Ltd.,** and **Submarine Cables, Ltd.,** last Saturday visited the circus at Earl's Court on the occasion of the Telcon's annual children's Christmas party. Mr. F. Leighton, general works manager, president of the Social and Athletic Club, and Mr. Letton, hon. secretary, saw them off from the works.

The annual distribution of prizes and certificates to the students and apprentices of the Woolwich Works of **Siemens Bros. & Co., Ltd.,** took place in the concert hall of the Siemens Sports Club on 8th January. Mr. W. T. Pope, M.I.A.A., labour manager and chairman of the Siemens Education Committee, took the chair and Mr. H. E. Humphries, M.B.E., managing director of the company, presented the awards which consisted of nine prizes and 125 certificates. Many parents were present and after the prize distribution they were entertained by a special performance of the play, "Madam Tic-Tac," given by the Siemens Players.

Mr. H. E. Humphries (managing director) presenting prizes to Siemens students and apprentices

At the annual dinner of the Nottingham Branch of the Electrical Industries Benevolent Association: (Left to right) Sir John Dalton, Mr. G. C. Russell, Mr. L. F. Jeffrey, Mr. C. R. King, Mr. T. H. Greaves and Mr. W. K. Martin



OBITUARY

Mr. M. G. Drake.—The death occurred at Gerrard's Cross on Sunday, at the age of eighty-two, of Mr. Mervyn George Drake, A.M.I.E.E., who for many years until his retirement from active service in 1938, was managing director of Drake & Gorham, Ltd. Brother of Mr. Bernard Drake, a founder of the company, he was associated with the organization since its earliest days. He remained on the board of directors until 1947.

Mr. Charles Remington.—The death occurred suddenly on 11th January at the age of sixty-eight of Mr. Charles Remington, at his home at Humberstone, Leicester. Mr. Remington had for the past eighteen years been a member of the technical staff of Gent & Co., Ltd.

Engineering Wages Inquiry

THE dual Court of Inquiry appointed by the Minister of Labour to investigate the circumstances of the wages dispute in the engineering industry resumed its hearing last week under the chairmanship of Lord Justice Morris.

Mr. J. Tanner, speaking for the Federation of Shipbuilding and Engineering Unions, said that their case rested on three factors: the rise in the cost of living, " spectacular " increases in productivity in the engineering industry and the large, continuing rise in profits. The unions, realizing the detrimental effects which a long-drawn-out struggle would have upon the country were anxious to arrive at a peaceful settlement. But they were so convinced of the justice of their claim that they could not accept the employers' complete rejection of that claim.

A percentage increase had been asked for, rather than a uniform advance, because it was desired to preserve the margin between skilled and unskilled workers. It was contended by the unions that the wage rates in the industry had not kept pace with the cost of living. The employers maintained that this was compensated for by the earnings from piece-work and overtime but this did not help the men who were on time rates. The employers' figures were misleading because most men were earning less than the averages which they gave.

After quoting figures to show the rise in profits he said that a 15 per cent wage increase would not mean more than an addition of 2½ per cent to total costs and that would not price British goods out of the export markets.

Speaking for the employers, Mr. B. Macarty, director of the Engineering and Allied Employers' National Federation, pointed out that a 7s 4d a week increase had been granted in November last. The employers could not accept the statement that there had been a fall in the standard of living of most engineering workers. He claimed that while between May, 1952, and June, 1953, there had been a rise of 4·4 per cent in the index of retail prices the average weekly earnings of adult male workers had risen by 6·56 per cent for time workers and 6·31 per cent for piece-workers.

Export figures showed a decline of 20 per cent for the year ended May last and during 1953 the profits trend had been adverse. The unions ignored the fact that profits were not all distributed; the greater part was retained in the business to finance operations.

On 12th January Mr. H. G. Brotherton, president of the Confederation of Shipbuilding and Engineering Unions, said that the employers were unwilling to allow the workers a fair share in the prosperity of the industry. This had led to frequent breakdowns in the

Mr. B. Macarty

Mr. H. G. Brotherton

negotiating machinery. Although the employers seemed satisfied that the engineering workers' wages were above the average for industry in general, this was an industry with a high proportion of skilled men. The employees would be disposed to refuse to work overtime if the employers persisted in setting off against the cost of living wages which included overtime and premiums.

Mr. Macarty said that the unions had failed to prove that most of their members were not working overtime last year. During an inflationary period and with rising production, higher profits were necessary to meet the situation. Even so the profits which firms were allowed to retain were insufficient for maintaining the development and plant modernization necessary to meet foreign competition.

The unions' estimate of £75 million as a measure of the cost of granting a 15 per cent increase in wages was wide of the mark. It could not be given without a disastrous general increase in export prices.

In response to Lord Justice Morris's request it was agreed that further evidence on the effect of a wage increase on costs and selling prices, and more information about export trade should be submitted at a sitting of the Court on 21st January.

On Thursday and Friday last week the Court dealt with the shipbuilding side of the subject.

Electrical Contracting Dispute

ALL last week the sporadic strikes organized by the Electrical Trades Union in the electrical contracting industry continued. Among the establishments affected were the Calder Hall (Cumberland) and Capenhurst (Ches) atomic power projects, the Southwick (Brighton), Chadderton and Bold (Lancs) power stations, the Appleby-Frodingham steelworks, Scunthorpe, the Abbey Works of the Steel Company of Wales, the atomic research station at Aldermaston (Berks), oil refineries at Coryton (Essex) and Ellesmere Port (Ches), airfields in Northern Ireland, a new gasworks at Portslade (Sussex) and at Olympia (London) where the Hotel and Catering Exhibition was being prepared.

Men employed at an electronics factory of W. H. Smith & Co. (Electrical Engineers), Ltd., were warned that if they ceased work on 18th January, as the E.T.U. had instructed them to do, they would be dismissed. Although the company is also in the electrical contracting industry these men are not covered by contracting industry agreements.

On Wednesday last week the strikers at Scunthorpe steelworks were addressed by an E.T.U. official. They were asked to vote in support of the Union's strike policy; it was later reported that 51 did so but 32 voted against the motion. At the same site seven electricians' mates decided to leave the Union as a protest against the strike policy.

Statements have been made on behalf of the Union and the National Federated Electrical Association. Last week, Mr. L. C. Penwill, director of the N.F.E.A., said that the employees of some member firms had struck under the threat of expulsion from the Union if they failed to obey its instructions. The Association had decided to take no action against the men who had been called out on selected sites. Later Mr. Penwill said that the selection of the sites by the Union clearly showed the political nature of its activities.

The secretary of the E.T.U. claimed on Thursday last week that about 1,000 men were " out " on fourteen sites. He said that if the employers locked their men out on Tuesday as a reprisal for Monday's one-day complete stoppage the men would be told to stay out until the Union gave them instructions.

The threatened 24-hour token strike took place on Monday. On behalf of the Union it was claimed that the response overwhelmingly endorsed the Executive Committee's action. At four meetings held in London full support was promised for a suggestion that all members in the contracting industry in the London area should cease work for the whole of next week.

On learning of this threat Mr. Penwill said he thought that the Union was imposing unnecessary hardship on its members but the N.F.E.A. would not be intimidated. He said that although it was impossible to give an accurate account of the extent of Monday's strike it was clear that the Union's orders had received far from unanimous support.

It is understood that the Union has instructed between 800 and 900 men to remain on strike indefinitely, among them 250 at Capenhurst and about 240 at Ellesmere Port.

In the House of Commons on Tuesday Sir Walter Monckton said that he had the report of the dispute under consideration. As matters stood at present he was satisfied there was nothing useful he could yet do.

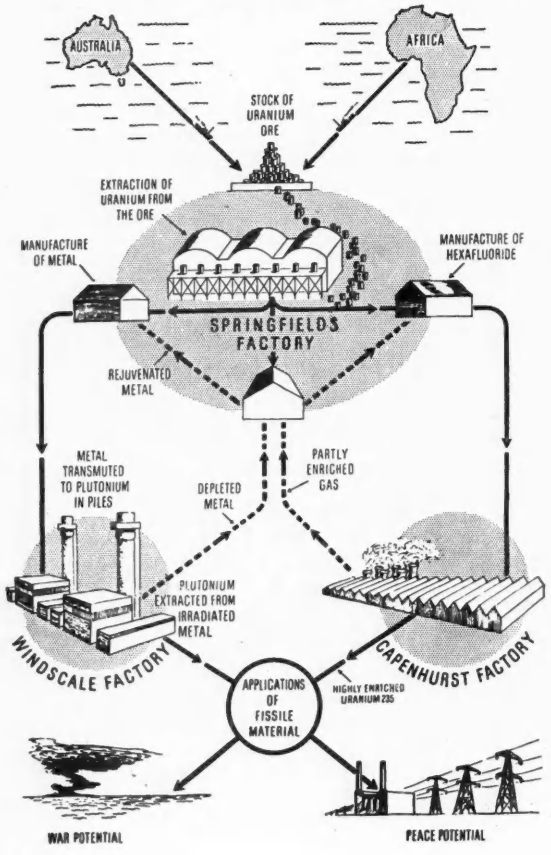
Britain's Atomic Factories

HOW fissile material is being produced in this country to-day for the production of power is described in a book* issued this week by the Ministry of Supply and the Central Office of Information. Intended primarily for the general reader, the book contains much that will be new to the engineer and scientist, especially a 16-page appendix on the physical basis of atomic energy plants.

The headquarters of the production organization, as distinct from that of research which is centred at Harwell, is at Risley, Lancashire, where designs and construction programmes are prepared for three factories: Springfields, near Preston; Windscale, near Sellafield (Cumberland); and Capenhurst in Cheshire. At Springfields uranium is extracted from the ore (from the Belgian Congo) not by smelting but by being dissolved in acid and then treating the solution to separate the uranium from impurities, first by chemical and then by metallurgical processes, and casting the metal for use in atomic piles.

Main products of the Springfields works are taken to the two other factories as indicated in the accompanying diagram. At the Windscale site of 300 acres, plutonium is produced from uranium in two atomic piles and afterwards chemically separated. The piles are of the slow-fission natural-uranium graphite moderated type and are gas-cooled at atmospheric pressure. Getting rid of the heat generated in this way was made possible by fitting fins to the cartridges containing the uranium rods; although not so efficient as pressure-gas cooling, this construction enabled plutonium production to be started a year earlier and was, unlike water cooling, inherently safe.

The world wide flow line for the production of atomic energy



Each pile consists essentially of a central core of graphite blocks pierced by horizontal channels containing rows of uranium rods sealed in aluminium containers, the whole assembly being surrounded by a graphite reflector. Air blown through the channels escapes up a chimney 415ft tall the filtered emissions from which are so diluted as to be harmless on return to earth. The radioactive central core is surrounded by a wall and roof of heavy concrete as a protection for operators. Steel rods containing neutron absorbing boron and hanging above the core control the power level of the pile and can be released from a control room to shut the plant down.

An advantage of plutonium over uranium 235 is that its extraction chemically from irradiated uranium is less complex than the separation physically from natural uranium. When the separation plant was designed the chemistry of plutonium was almost unknown and only 20 milligrams of the metal—enough to cover a pinhead—were available for experiment. Because of the intense radioactivity of the uranium removed from the pile, the separation plant had to be built so that, once production had started, it could continue working throughout its life by remote control. No subsequent repairs, adjustments, or even normal maintenance work, would be practicable. To provide for the safe discharge of effluent heavy iron pipes were laid two miles out to sea in half-mile lengths. The first plutonium was produced in the factory 4½ years after entry to site. The Windscale laboratories, nearly fifty in number, cover 2½ acres and deal with radioactive substances.

At the third factory, Capenhurst, natural uranium consisting of a mixture of two isotopes, U238 and 235, is converted to a gas, which is repeatedly passed through minute holes in porous membranes; the lighter (fissile) molecules coming through first are pumped away. Since air must not enter a diffusion plant, the many miles of pipework, joints and compressors must be vacuum tight and evacuated as completely as a wireless valve.

A chapter on the effects of radioactivity on health indicates that, through the precautions taken, atomic factories are among those most free from occupational hazards.

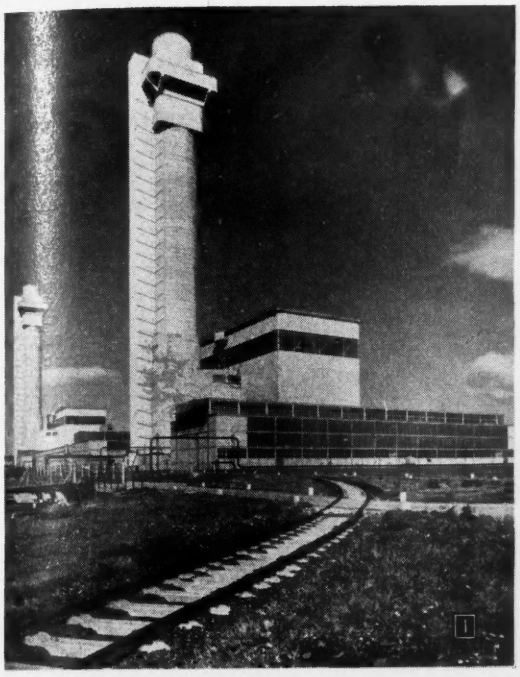
It is claimed that the design and construction of the factories is an engineering achievement that is unsurpassed in the history of British industry, all dates for completion having been met within a few weeks. The chapter on Risley's organization and methods is certainly impressive. An atomic power station is already being built.

In the future, it is stated, the enormous quantities of heat released in fission will no longer be regarded as an unwanted product in the production of plutonium but as the primary product. The only method likely to be practicable is to treat the reactor as a furnace and transfer the heat generated in it to a conventional electrical generating plant. The principle of "breeding" by which more fissile material is produced than is consumed is discussed. It is pointed out, however, that this will first entail the building up of adequate stocks of plutonium 239 or U233.

* "Britain's Atomic Factories." By K. E. B. Jay, B.Sc., A.Inst.P. (Division of Atomic Energy, Ministry of Supply). Pp. 100; plates, 16; diagrams, 9. H.M. Stationery Office, 5s.

The development of atomic energy factories has for a long time gripped the imagination of most electrical engineers. We feel that the illustrations below, with the supporting text on the opposite page, will help to give a better understanding of this absorbing subject

(1) The piles at Windscale as at present constituted. (2) "Hand and foot" radiation monitors in use. (3) One of the control desks, the instruments and controls regulating the plant below them. (4) The cyclones which extract the dust from the uranium ore crushing plant. (5) Inside a uranium purification plant. (6) Dryboxes in use in a "hot" laboratory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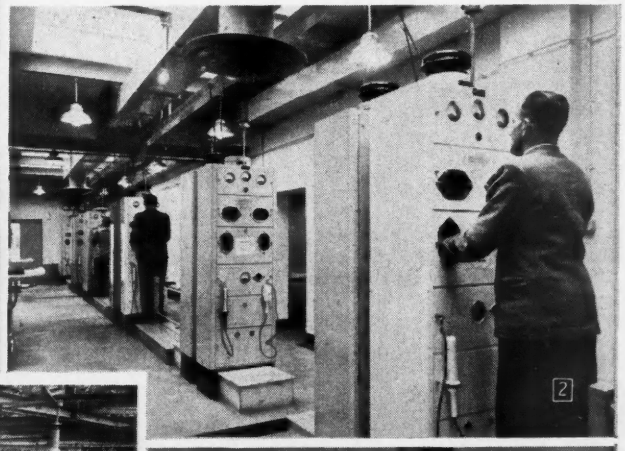
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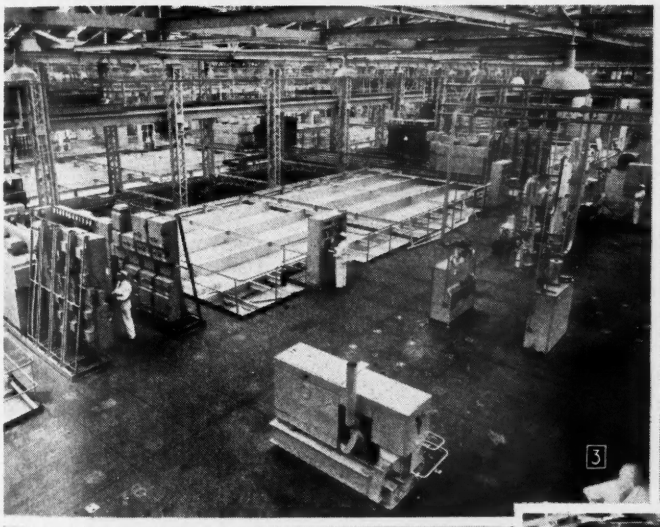
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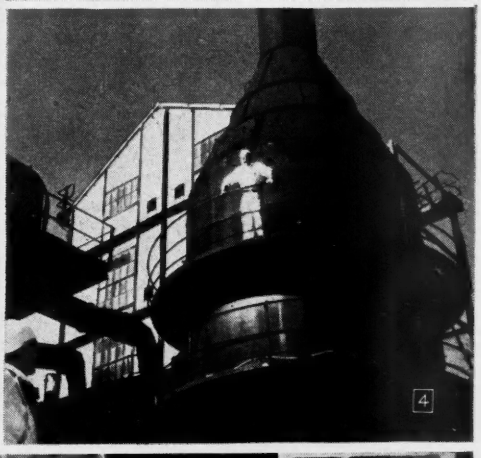
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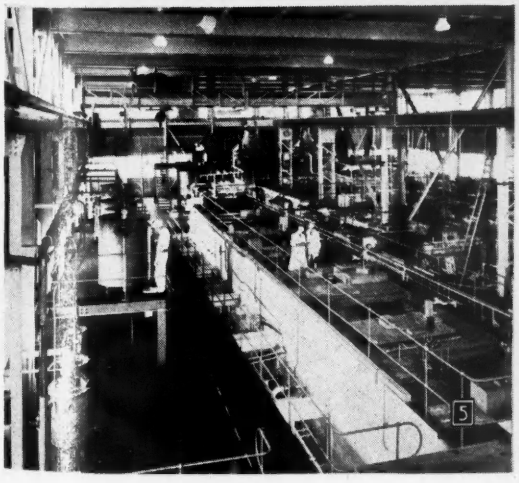
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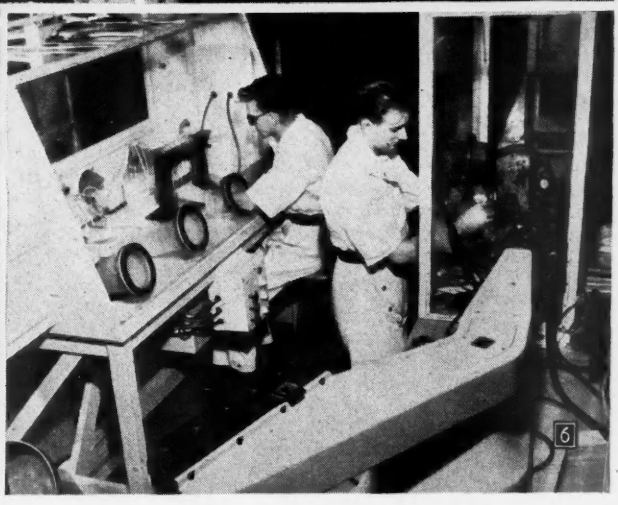
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INDUSTRIAL NEWS

American Plant Contracts

IN THE United States Senate last week, Senator Malone (Republican) demanded the withdrawal of the contract for two generators for the McNary Dam from the English Electric Co. on the grounds that the award was detrimental to the United States' economic and military interests. He referred to the loss of tax and wage payments and went on to suggest that it would be impossible for a British company to repair or replace the generators in the event of damage or destruction during a war.

The Senator asked what weight and consideration had been given to (1) loss in revenue and taxes; (2) past performance and experience of the competitive bidders; (3) factors of repair and replacement in time of war or other emergency; (4) loss in man-hours and wages to American workers; and (5) what state or municipal officials were consulted in connection with the award. Senator Malone declared that the contract award to a British company was an example of a "misguided foreign trade policy." This policy, he said, was to divide United States markets, money, and work with the nations of the world at the expense of the American taxpayer, investor, and working men and women.

Although there were two lower foreign offers, a contract for a transformer for the Bonneville (Oregon) power project was awarded last week to the Westinghouse Electric Corporation, East Pittsburgh. That company's tender was $771,346 "subject to a possible 20 per cent increase," against a bid of $586,000 by the American Elin concern (an Austrian subsidiary) and $634,890 by the English Electric Export & Trading Co.

The Department of the Interior gave as the reason for the acceptance of the higher American tender the requirement of the specifications that firms bidding should have had considerable experience in the design, construction, testing and actual operation of such transformers.

Visit to Moscow

We reported in our issue of 11th December (p. 1336) that a party of thirty prominent British industrialists was arranging to visit Moscow to investigate the possibilities of trade between this country and Russia. Now we are informed that approval to the visit has been secured for discussions with the All-Union Chamber of Commerce in Moscow. The party, which is led by Mr. J. B. Scott, sales director of Crompton Parkinson, Ltd., includes representatives of Blaw Knox, Ltd., the Brush Group, Enfield Cables, Ltd., Johnson & Phillips, Ltd., Lancashire Dynamo & Crypto, Ltd., J. Stone & Co., Ltd., Mullard Overseas, Ltd., and Ruston & Hornsby, Ltd. They hope to leave before the end of this month.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £156 os od
COPPER, H.C. Electro	ton £215 os od
Fire Refined 99·70%	ton £214 os od
Fire Refined 99·50%	ton £213 os od
COPPER Tubes ..	lb 2s 2d
Sheet	ton £273 10s od
H.C. wire and strip	ton £250 os od
LEAD, English ..	ton £82 15s od
Foreign	ton £81 os od
MERCURY	flask £61 15s od
TIN, block (English) ..	ton £645 os od
ZINC, G.O.B. Foreign	ton £68 os od
Electrolytic	ton £69 10s od
BRASS Tubes (solid drawn)	lb 1s 9½d
Sheet	ton £229 5s od
Wire	lb 2s 4⅜d
PHOSPHOR BRONZE Wire	lb 3s 6⅞d
PLATINUM	oz £27 os od
RUBBER, No. 1 R.S.S. spot	lb 16⅞d–17⅛d

Cooker Window Display

The Simplex Electric Co., Ltd., has installed a special "Creda" heavy duty cooking equipment window display at its London showrooms, 217-219, Tottenham Court Road, to tie-up with its stand at the Hotel and Catering Exhibition now being held at Olympia. The window display includes a wall suite of "Creda" unit type equipment, a griller complete with stand, and a "Creda" 6-16-60 range.

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 16th January is deemed to be 141s 6d. The "cost of material" figures are:—

For electrical machinery and equipment the Board of Trade index figure published on 16th January is 157·3.

For turbo-generating and allied plant: materials used in mechanical engineering industries, 147·6, blast furnaces and iron and steel smelting and rolling (40 and 41), 144·0, price of ⅝in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 15th January), 3s 4½d per lb. Outstanding contracts covered by the B.O.T. intermediate products index: the index figure for intermediate products (16th January) is 351·6.

Switchgear for India

It is reported that the Brush Electrical Engineering Co., Ltd., has received an order valued at £60,000 for h.v. and l.v. switchgear for the Government of Saurashtra, India. The order was received despite a lower tender by a German concern.

Large Lighting Contract

One of the largest orders ever placed for the lighting of a single building, totalling over £70,000, has been received by the General Electric Co., Ltd. It covers hot cathode and

Display of "Creda" heavy duty cooking equipment at the London showrooms of the Simplex Electric Co., Ltd.

cold cathode fluorescent lighting fittings to be installed in the engineering workshops and administrative offices of the new British Overseas Airways Corporation headquarters at London Airport, construction of which has now reached an advanced stage. All the fittings have been specially designed for this installation, and many of the cold cathode units in the engineering workshops will contain eight tubes. The electrical contractors are Rashleigh, Phipps & Co., Ltd., and the consulting electrical engineers for the building are E. Wingfield, Bowles and Partners. The work is being carried out under the supervision of the Air Ministry Works Directorate.

"Watt's Cooking"

Philip Harben, the well-known chef and TV personality, will appear in a show for Jack Payne entitled "Watt's Cooking." The entire equipment for his act is composed of electrical appliances. A manufacturer has been called in to arrange the stage setting which includes two electric cookers, an electric sink, a refrigerator and an electric mixer. With a trial week at Portsmouth starting on 25th January and a second at Nottingham from 8th February, the show will go on the road for twenty weeks. Leaflets containing special recipes by Philip Harben will be available from Electricity Board district showrooms during the show.

Fire at Leyton Works

There was an outbreak of fire at the works of the Reliance Electrical Wire Co., Ltd., at Leyton on the evening of 9th January, but thanks to the prompt attendance and excellent work carried out by the Fire Brigade and the Salvage Corps the damage was very limited, and plant was completely unaffected. An emergency squad recruited from amongst local employees worked throughout Sunday to such good effect that the factory commenced work on the Monday under almost normal conditions.

Locomotives for Australia

The first of forty-eight 1,105 h.p. class X diesel-electric locomotives for the Western Australian Government Railways was shipped from Liverpool on the s.s. *Gloucester* for Fremantle on 14th January. The electrical equipment of these locomotives is being made at the Metropolitan-Vickers Works at Sheffield and Trafford Park, and the mechanical parts are being made and the locomotives erected by Metropolitan-Vickers – Beyer, Peacock, Ltd., at Stockton-on-Tees. They are powered with diesel engines manufactured by Crossley Bros., Ltd., Openshaw. This is the largest diesel-electric traction order ever placed with a British firm, being valued at £2,250,000 sterling. The mechanical design of the locomotives has been dictated by the service requirements. These entail the combination of a high diesel-engine power with a low axle load, the latter being necessary to permit their use as "universal" locomotives on the W.A.G.R. system.

The first of forty-eight Metropolitan-Vickers diesel-electric locomotives being loaded on board ship at Liverpool for shipment to Australia

Each locomotive is equipped with a diesel engine of the two-cycle type, which, under the operating climatic conditions and the specified requirements, delivers 1,105 h.p. The locomotives were designed for an axle load of 10 tons, and a complete locomotive, including 1,000 gallons of fuel, weighs 77½ tons. The completed locomotives were transported from the MV-BP Stockton Works to Liverpool by road. A special low-loader had to be provided to enable each locomotive to be delivered on board ship in one piece.

Electricity Account Disputed

Although a meter had registered electricity to the value of £9 16s 7d Judge F. K. Archer, Q.C., refused a claim for that amount made by the South Eastern Electricity Board at Hastings County Court on 12th January. Mr. R. K. Lamplugh, for the Board, then said that the Board would accept £5, to which the defendant, Mrs. K. Castle, of Bexhill, agreed.

Mr. Lamplugh said that because of the large amount the meter was checked four days after the reading and found to be correct. Later it was tested again and found to be only slightly in error. Mrs. Castle told the judge that the bill, which was for the first quarter of 1953, was excessive. The bill for the corresponding quarter of 1952 was £4 7s 2d and the conditions were exactly the same in each quarter. She rarely used electricity for heating.

The judge said that if they had all that information from Mrs. Castle it was better than the meter but Mr. Lamplugh said he did not agree. The judge then remarked: "You have a higher regard for the machine than I have. I know the odd tricks they can play. Ask any electrician. If there is any dispute the thing to do is to charge according to the corresponding quarter of the previous year, unless conditions have changed." At the close of the case he said: "The Board is a public authority and it is their duty to be careful and accurate and see that they do not charge too much."

Instrument Manufacturers' Luncheon

Speaking at the annual luncheon of the British Industrial Measuring and Control Apparatus Manufacturers' Association, held at Brown's Hotel, London, on 12th January, Mr. W. G. Thomas (chairman) said that British equipment could compete at every point with that of the Americans and Germans. The exports of the instrument industry as a whole had increased by 30 per cent. Special attention had been paid by the Association to publicity in the past year, and the B.I.M.C.A.M. Handbook had been well received. The second British Instrument Industries Exhibition held at Olympia in July last had helped in raising the prestige of the Association. Other speakers at the luncheon were Mr. H. W. Blake (president of the Association), Mr. D. Wilson (chairman of the Council of British Manufacturers of Petroleum Equipment and first president of the European Federation of Petroleum Equipment Manufacturers), and Col. Sir Harold Smith (chairman of the Gas Council).

Swiss Television Order

Three "Emitron" mobile microwave links ordered by the Swiss Post Office are to be augmented by a further three complete units. These will be used in connection with the Anglo-European interchange of television programmes recently announced.

Festival Hall Heat Pump

We learn from the *Daily Telegraph* that the heat pump which was installed in the Royal Festival Hall, London, in 1951 as an experiment in fuel-saving in large buildings is not to become a permanent installation, the London County Council having decided not to acquire it from the Ministry of Fuel and Power, from whom it is now being rented, because of its uneconomic operation. It is said to be the largest

heat pump in the world and it was built at a cost of £103,000. The pump is already out of use for heating, but it will continue to serve for cooling until normal refrigeration plant is installed. The heat pump and its performance were described in a paper read before the Institute of Fuel on 22nd December by Messrs. P. E. Montagnon and A. L. Ruckley, and the paper was reported in the *Electrical Review* of 1st January, 1954.

Post Office Wage Claim

A claim has been submitted by the Post Office Engineering Union for increases in the pay of its members. The amount varies in accordance with the grades. It is stated that the granting of the increases would raise the wages total of the Post Office Engineering Department by about 12½ per cent.

Lighting for Textile Industries

Thorn Electrical Industries, Ltd., held an exhibition at its Stevenson Square, Manchester, showrooms from 11th to 15th January demonstrating the many applications of specialized lighting to the textile industries.

Television in New Zealand

Recently Mr. C. R. Thompson, a senior television engineer with Pye, Ltd., left England for New Zealand, where he has prepared a studio, complete with television cameras and transmitting equipment, which will put out New Zealand's first television broadcasts.

Programmes are being broadcast for about four or five hours daily from the Wellington Show and Industrial Fair; they started on 7th January and will continue until the 27th.

Films for Industry

At the Board of Trade Cinema, Whitehall, on Monday four films of interest to industrialists were introduced by Mr. Henry Strauss, Parliamentary Secretary to the Board of Trade. They were "Watch Your Step" (a "safety" film), "Principles of Lubrication," "Cutting an External Acme Thread," and "Introducing the New Worker."

The four films displayed are only a small sample of the films which can be rented or purchased from the Central Film Library of the Central Office of Information. A catalogue of these films (British and overseas) is available, price 1s 6d, from the Central Film Library, Government Building, Bromyard Avenue, Acton, W.3, the Scottish Central Film Library, 16–17, Woodside Terrace, Charing Cross, Glasgow, C.3, or the Central Film Library of Wales, 42, Park Place, Cardiff. It is divided into twenty-nine sections and sub-sections and lists 273 films on a variety of industrial subjects including civil, electrical and general engineering, foundry and workshop practice, metal fabrication, steelmaking, telecommunications, fuel economy, industrial management, and plastics.

Educational

A course of six university extension lectures on "Atomic Energy" is being given at the Beveridge Hall, Senate House, Malet Street, W.C.1, on Wednesday evenings. The first of the series was given on Wednesday last. The lectures are being held under the auspices of the Department of Extra-Mural Studies, University of London, and the Atomic Scientists' Association. The fee for the course is 10s (members of the Association 5s), or 2s for single lectures, and applications for tickets should be made to the Cashier, University of London, Senate House, W.C.1.

Advertisement Correction

In the advertisement on page 47 of this issue the dimensions of the new Ashley "Duo-base" switches should be given as 2⅛in square by 1/16in deep.

Floor Maintenance

A display of their new range of floor maintenance machines for industrial purposes was organized by Cimex-Fraser Tuson, Ltd., at Seymour Hall, London, W.1, on Wednesday and Thursday of last week. Officials from hospitals, schools and industry in Britain and overseas were present and demonstrations were arranged to show the thorough and speedy cleaning which can be achieved where shortage of staff and high costs of maintenance are important factors.

One of the machines on show, the "Eagle," scrubs and dries in one operation, and can be operated by a single person, covering more than 4,000 sq ft an hour. Other machines demonstrated were the "Bittern," a heavy duty scarifying machine for use in industrial plants, the "Mallard" and "Vulture" scrubbing and polishing machines, and the "Dipper" suction dryer.

Cimex-Fraser Tuson floor maintenance machine display

E.W.F. Dinner

This year's annual dinner of the Electrical Wholesalers' Federation will take place at the Dorchester Hotel, London, W.1, on 18th March (6.30 for 7 p.m.). It will be preceded by the annual general meeting at the Waldorf Hotel.

Coronation Broadcasting

Standard Telephones & Cables, Ltd., has issued a well-produced, illustrated brochure describing its contribution to the sound and television transmissions of the Coronation ceremony and drive.

Trade Announcements

The **Pyrene Co., Ltd.,** has entered into a contract for the purchase of the whole of the share capital of the Pyrene Manufacturing Co. of Canada, Ltd.

Thermodare (Great Britain), Ltd., has moved to 79–80, Petty France, London, S.W.1 (telephone: Abbey 1060 and 3348).

Catalogues and Lists

A.E.G. Electric Co., Ltd., 131, Victoria Street, London, S.W.1.—An illustrated leaflet illustrating single- and three-phase and d.c. motors up to 200 h.p.; split-phase and capacitor start motors up to 2 h.p.; and flameproof motors up to 20 h.p. Also an export price list of motors.

Electrical Trades Supply, Ltd., Albion Buildings, Vesey Street, Birmingham, 4.—168-page indexed catalogue of electrical fittings, accessories and domestic appliances, together with 30-page price list.

Kelvin-Norton Electric Co., Ltd., 3, St. Martin's Road, Stockwell, S.W.9.—Illustrated brochure describing the "Kelvin-Norton" overhead grid system for low voltage handlamps.

Funditor, Ltd., Woodbridge House, 3, Woodbridge Street, London, E.C.1.—Illustrated catalogue describing the company's range of industrial electric furnaces, together with a leaflet on the new metal auto-loader.

Belling & Co., Ltd., Bridge Works, Enfield, Middlesex.—56-page illustrated priced catalogue of electric fires and cookers.

Midland Silicones, Ltd., 19, Upper Brook Street, W.1.—Illustrated booklet on the properties of "Silastomer" silicone rubber.

Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.—Wallet containing technical literature concerning capacitors.

Barries Electrical Agencies, Ltd., King Street, Brighton.—Illustrated priced leaflet on the "Stadium" shock-proof inspection lamp.

GENERATION AND DEVELOPMENT

Output in 1953

ALTHOUGH higher than in 1952, last year's rate of expansion in electricity generated—5·7 per cent—fell below the level that had seemed likely earlier in the year. Up to the beginning of September the average increase was 7·3 per cent; since then the monthly reports have recorded a marked decline and in December, as shown in the accompanying table, the gain was only 0·1 per cent (following 2·6 per cent in November). Whereas in 1952 wintry weather set in early and the simultaneous maximum demand occurred in December, the weather last autumn was unusually mild and this, no doubt, was largely responsible for the output trend. Details were given last week of the new plant installed by the British Electricity Authority. For the country as a whole (including the North of Scotland) the Ministry of Fuel and Power's statement shows that the total installed capacity at the end of December was 19,169 MW, a net increase during the year of 1,429 MW (8·1 per cent).

ELECTRICITY GENERATED AND PLANT INSTALLED*

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total†		
British Electricity Authority ..	3,459	86	11·3	6,312	52	6,374	5,995	18,602
N. of Scotland H.E.B. ..	17	1	1·2	27	127	159	157	567
Total for December, 1953 ..	3,476	87	12·5	6,339	179	6,533	6,152	19,169
Corres. total for December, 1952	3,660	89	6·5	6,383	124	6,525	6,157	17,740
Increase or decrease, per cent	−5·0	−2·2	+93·8	−0·7	+44·4	+0·1	−0·1	+8·1
Total, 1953 ..	35,536	907	96	64,068	1,283	65,512	61,631	
Total for corres. months of 1952	34,485	847	68	60,563	1,268	61,989	58,398	
Increase or decrease, per cent	+3·0	+7·1	+41·2	+5·8	+1·2	+5·7	+5·5	

* Comprising all generating stations controlled by the British Electricity Authority and the North of Scotland Hydro-Electric Board.
† The total includes 9·5 million kWh generated by oil engines and 5·1 million kWh by waste heat plants in December, 1953.

Charges at Portsmouth

Drawing attention to the facts that Portsmouth, before vesting date, had enjoyed low charges for electricity through efficient management, seaborne coal and a compact distribution area and had suffered "enormous" increases under the new commercial tariff, the Port of Portsmouth Incorporated Chamber of Commerce recently asked the Central Authority whether the Southern Electricity Board ought not to be directed to make Portsmouth a special area within the S.E.B. Area under Section 37 (6) of the Electricity Act, 1947. The Central Authority replied that, *prima facie*, there appeared to be no case for intervention, but it was open to the Chamber to put this case before the Consultative Council. The Chamber thereupon appealed to the Consultative Council to advise the Central Authority that, in the interest of its economic welfare, Portsmouth should be deemed a special area wherein the standard tariffs should be varied. At the Council's meeting at Reading on 12th January, under the chairmanship of G/Capt. J. C. M. Hay, O.B.E., consideration was given to the Chamber's case as voiced by Coun. Smith and Mr. Edwards, but it was decided, with one contrary vote and an abstention, not to support the application of the Chamber of Commerce.

Classification of Premises

The Southern Electricity Consultative Council is to take up with the Board the classification of premises of a domestic nature which at present receive their supplies under the commercial tariff. These examples which have been brought to the Council's notice are a home for elderly people, a girls' hostel and a convent.

Boards not Responsible for Delay

Following investigations into the delay in completing new houses in the borough, Gateshead Town Council has absolved the electricity, gas and water undertakings from blame. It had been alleged earlier that the handing over of new houses had been held up because of the delay in installing gas, electricity and water but the Council has decided that the reports of the borough engineer on the delays were erroneous. Both the Gas and Electricity Boards said they operated a system of priority whereby labour was moved from one site to another to ensure that services were installed when required and no delays occurred.

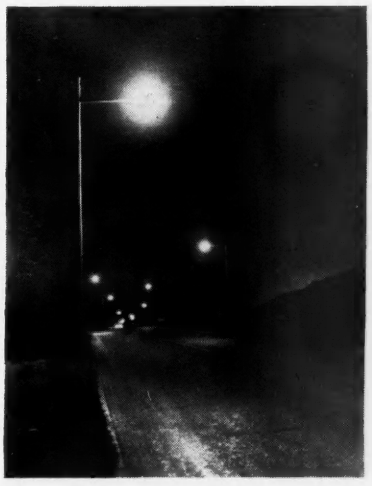
Electricity Failure in Lancashire

Large areas of Lancashire were without electricity for periods ranging from ten minutes to an hour on Sunday night. Mr. A. R. Cooper, North Western divisional controller, B.E.A., said that the trouble probably arose from sea spray, blown by high winds, settling on the grid insulators and forming a conducting layer of salt. This caused a leak to earth which was checked by an automatic trip. Many of the main grid lines in the north western division were affected. The gale on Sunday blew down a power cable in Yorkshire and several villages near Bridlington were without electricity for more than an hour.

Scottish Peat-burning Station

Work is proceeding steadily on the project to erect a peat-burning power station at Altnabreac in Caithness. Actual constructional work will demand dry weather but the plant is on order, and plans are being prepared for the installation of the first plant of its

Over 1,500 B.T.H. tungsten street lighting lanterns (SL600 series) are in use on the network of roads covering the Iraq Petroleum Co.'s oilfield at Kirkuk, Northern Iraq. The lanterns house "Mazda" 500 W or 150 W lamps



type in the country. The turbine is understood to be a development on the peat-burning gas turbine which ran successfully at John Brown & Co.'s works for 1,000 hours. A very great deal of preparatory work will be involved as the site is both isolated and barren.

Dust Emission

Newcastle-on-Tyne City Council is recommended by the Health Committee to take legal proceedings against the British Electricity Authority to abate the nuisance caused by dust from Dunston power station. For some months complaints have been made about a grey dust settling on property in the west end of Newcastle. The B.E.A. has stated that it is doing all it can to remove the nuisance.

Financing Rural Development

At the next meeting of Consultative Council chairmen with the Minister of Fuel and Power the chairman of the Southern Council is to raise the question of Government assistance to replace the capital contributions and/or revenue guarantees required of consumers to help finance otherwise uneconomical schemes.

South Denes Power Station

Great Yarmouth Town Planning Committee has recommended approval of further plans and elevations, submitted by the British Electricity Authority, for the proposed South Denes generating station.

Substation Extension

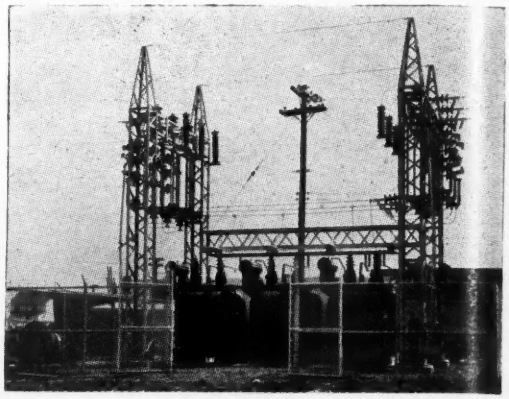
Wallasey Town Planning and Building Plans Committee has approved plans for an extension of the substation at the Poulton generating station, Limekiln Lane.

Power Station Interconnection

The British Electricity Authority has erected overhead lines across the Tyne to connect the new power stations now being built at Stella North and Stella South. The conductors are suspended on towers 90ft high, giving a clearance of not less than 50ft above high water mark. The Stella North and South power stations are expected to be completed in two years. It is understood that the B.E.A. is to seek permission shortly to go ahead with a new power station in the Blyth area of Northumberland.

Progress in North East

During the months of September, October and November of last year, 134 substations were brought into commission by the North Eastern Electricity Board, according to a report submitted to the quarterly meeting of the Consultative Council at Newcastle-on-Tyne. High voltage supplies were afforded to nine industrial and commercial consumers, while 146 miles of cables and mains were also laid. During the three months 111 farms were connected and negotiations were completed for supplying 426 more, while nine villages were brought on to supply in the Tyne, two each in the Wear and Harrogate, and three in York Sub-Areas. The Board has approved further developments costing £758,250 involving supplies for 70 housing schemes and 126 rural supplies. The report announced that the work of erecting a line to Whittonstall (Tyne Sub-Area) which had been held up owing to open-cast coal borings, had been put in hand.



A 30 kV outdoor substation which has just been put into operation at St. Hubert, Quebec. It is equipped with three 1,000 kVA Denis Ferranti single-phase transformers supplied to the order of the Canadian Government

Library Lighting

Manchester Corporation Libraries Committee proposes to install fluorescent lighting at various libraries at a cost of £3,275. A report to the City Council states that the changes will provide better conditions for the staff and the public and greater economy in the use of electricity.

OVERSEAS

Water Power in Nyasaland

Reviewing progress in Nyasaland in a recent speech to the Legislative Council, the Governor said that the main purpose of what might be described as the capital element of the development plan had been the improvement of communications, and supplies of power and water. The Shire Valley project now being surveyed by their consultants involved the stabilization of the level of Lake Nyasa by building a barrage at the outlet with the resulting control of the flow of the Shire River, the development of the very large potential of hydro-electric power on the falls of the Shire River, and the reclamation and irrigation of wide areas of the very fertile lower Shire Valley. The completion of this scheme would, by making possible the establishment of industry with cheap hydro-electric power and by developing agriculture in the lower Shire Valley, revolutionize the whole economy of Nyasaland. They could only hope that the initiation of construction work on this project would not be long delayed.

Drought Effects in Portugal

Electricity output in Portugal during January–September was 1,003 million kWh, against 991 million kWh in the corresponding period of 1952. Owing to the drought, hydraulic output decreased from 895 million to 673 million kWh, the deficit being made up by an increase in thermal production from 96 million to 330 million kWh. As a result, the electro-chemical industry (dependent on hydraulic supplies) suffered, but local coal production received a stimulus.

Generation in Cape Town

The Electricity Committee has recommended to the Cape Town City Council that the city should retain its independence in the generation and distribution of electricity, and should go ahead with the building of a new municipal power station when circumstances are favourable. The Council already owns the Table Bay power station and the old Dock Road power station. A decision on whether the city should build another power station, or rely solely on the Electricity Supply Commission for future needs in excess of the capacity of the two existing stations, has been pending for many months. The Committee proposes that the Council agree in principle to build another power station, the date of erection to be determined when circumstances are favourable and that the city electrical engineer should investigate and report on the most suitable sites at the earliest opportunity. It is stated that it will not be possible to complete the building of a new power station before 1959.

Yukon Project

It is reported that a mining group is to build a pilot plant to start a £1,000 million power development in the Yukon. Tunnels will be driven through a section of the coast range south of Atlin Lake and it is believed that some 4,300,000 to 4,500,000 h.p. can be developed. The major plan is to develop a large industrial site on the Taku River.

NEW ELECTRICAL EQUIPMENT

Roasting Oven

THE "Creda" HC. 4905 general purpose roasting oven which has been introduced by the SIMPLEX ELECTRIC CO., LTD., Broadwell, Oldbury, Birmingham, conforms to the "Creda" unit type specification of heavy duty cooking equipment.

Special features include a close-fitting oven door with concealed adjustable oven ventilators, and fully automatic heat control by two-stage thermostat to give fast initial heat-up. Fuses, thermostats, switches and elements are easily replaced from the front.

The oven interior is finished in a mottled blue vitreous enamel, and is provided with four runner positions, two grid shelves, a browning tray and a full-sized roast pan. The total capacity is 4½ cu ft, and the overall dimensions are 2ft 10in high by 2ft 11½in wide by 2ft 4½in deep. The total loading is 4·4 kW. The projection-free exterior is finished in silver-grey vitreous enamel, alternative colour schemes being available at a slight extra cost.

Poultry Brooder

With the introduction of its "Infraglo" poultry brooder, PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2, has placed within the reach of domestic poultry keepers many advantages available to the professional poultry breeding world. The use of infra-red rays in the rearing of chicks has already been well tried and tested. Under this system it has been found that the birds grow sturdier and feather more rapidly, the warming rays penetrating deep into their bones. This system also allows for closer supervision of individual chicks, and the gradual cutting down of the heat intensity as they approach maturity.

The new brooder comprises an infra-red lamp, lampholder and protective canopy; its price is 28s 6d. The makers claim that it is extremely economical to operate, consuming only one unit of electricity for seven hours' running, and that the average life of a lamp is 5,000 hours.

Axial Flow Fans

"Plannair" axial flow blowers are made by CAMACK BROWNE, LTD., 140, Park Lane, London, W.1, for airborne use and operation at high altitudes to provide efficient cooling in radar and radio cabinets, instrument panels, transmitter cubicles and other electronic equipment where local high temperature conditions occur. They are robustly constructed, but are light, compact, and will withstand vibration, shock and explosions.

All the light alloy castings are shot blasted and anodized in self colour. The blower assembly is dynamically balanced and fully "tropicalized." The motor shaft is made of stainless steel and the windings are impregnated with tropical varnish.

The standard models are fitted with two flanges but either of these flanges may be omitted, or the unit can be supplied without flanges, for clip mounting. They can operate in any position. The motors, which are rated for continuous operation at high ambient temperatures, are totally enclosed and the surface cooling arrangements provide adequate dissipation of heat even under tropical conditions. Both a.c. and d.c. units are available to suit a wide range of requirements.

Heated Washing Machine

The latest addition to the range of "Servis" washing machines produced by WILKINS & MITCHELL, LTD., Darlaston, South Staffs, is a new competitively priced model incorporating a built-in water heater, turbo-spinner, centrifugal pump and a geared hand wringer.

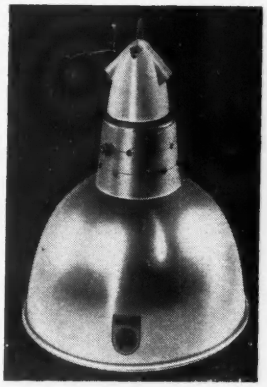
The tub holds 10 gallons of water and has a capacity of 6 lb of dry wash. Emptying is carried out by means of a built-in ⅙ h.p. centrifugal pump, the controls being on the front panel together with those for the motor and heater.

Effortless wringing is achieved by means of a gear drive giving a two to one reduction. When not in use, the wringer handle is swung inboard and fits neatly into a recess in the lid.

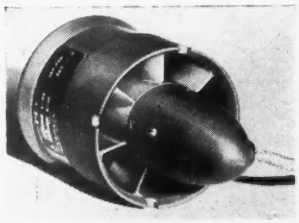
The offset vortex swirl of the 10in turbulator is claimed to provide a gentler method of cleaning clothes. Under the turbulator is fitted a 2 kW heating element.

When the machine is in use the flat-topped cover lifts off and can be attached to the back to serve as a receptacle for clothes after wringing. For easy movement, the machine is fitted with built-in castors at the rear. The casing has a lustrous white finish with chromium and black rubber trim and the overall dimensions are 32in high by 20in deep by 18in wide.

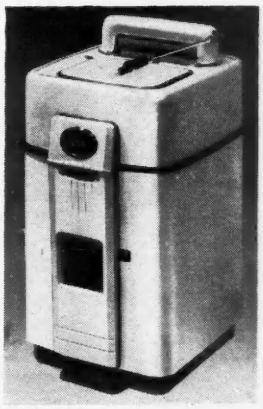
The retail price is £37 16s 0d plus £12 3s 9d purchase tax in the United Kingdom.



Above: Philips "Infraglo" poultry brooder

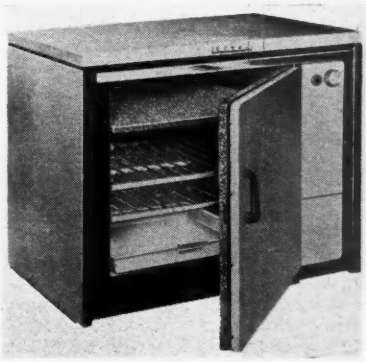


"Plannair" axial flow blower with 24/28 V d.c. 6,500 r.p.m. motor



"Servis" electrically heated washer

"Creda" general purpose roasting oven



Financial Section

STOCKS and SHARES

STOCK EXCHANGE markets remain obstinately cheerful in the face of continued anxiety about industrial wages problems. Gilt-edged stocks have been inclined to dullness, but the persistent demand for industrials, finding an increasingly small amount of stock on offer, kept prices inclined upwards along a broad front. Radio shares were a particularly good and active section of the electrical markets. Something of a lull exists so far as company dividend and earnings declarations are concerned, but it may be noted that one of the industrial market's main events—the Woolworth results—was notable not so much for a small increase in the distribution as to the disclosure of a £2 million charge for excess profits levy, which has since ceased to operate. Prospective relief from this imposition in the current year is very much a factor in the assessment of the shares of many companies, including numerous electrical firms of which a few examples were noted here last week.

Upward Trend

Many of the established leaders in the electrical equipment market are a shilling or more to the good over the past week. These include G.E.C., A.E.I., English Electric, B.I.C.C., Automatic Telephone, Siemens and Enfields. Clarke Chapman again rose in anticipation of next month's results, and among others showing useful improvements were Westinghouse Brake, Lucas and Henley's. Parnall (Yate) were active and higher at 5s 3d and Strand Electrics were marked up to 8s, with a bargain recorded at 1s above that. Sturtevant and Wolf Electric showed up particularly well in rising 2s and 1s 6d respectively. Other changes worthy of note were advances in Cable & Wireless stocks, and Hoover and H. J. Baldwin shares.

Brush Electrical

There has not been a great deal of activity in the 940,000 six per cent preference shares issued four months ago by the Brush Electrical Engineering Co., but they have rather more than maintained the price of 20s at which they were offered to ordinary stockholders, and they sustain interest by virtue of the attached conversion rights. These give holders the option, at twice-yearly intervals, of turning each £1 stock into four 5s ordinary units, a premium of 1s being payable on each unit taken up. With the existing units quoted below par, the option is of no immediate value, but it still has ten years to run. Meanwhile, the shares, at 20s 6d, show a return of nearly 6 per cent, and the board was confident at the time of the issue that, in the ordinary course of events, earnings of the group should cover dividends on this and the other preference stock with a margin of profit.

Telephone Properties

Fresh developments concerning shareholders in Telephone Properties

Week's Price Changes

Company or Board	Nom. Value	Middle price 18th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1953 Highest	1953 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	90	+½	3	3	3 6 9	90	83⅞
Brit. Elec. 1974/77	100	89	+½	3	3	3 7 5	89	82
Brit. Elec. 1976/79	100	94		3½	3½	3 14 6	94¼	88¼
Brit. Elec. 1974/79	100	105	+½	4¼	4¼	4 1 0	104	99½
Overseas Electric Supply								
Calcutta Elec.	£1	19/-	−6d	6†	6†	6 6 4†	21/-	18/-
East African Power	£1	22/-		7	7	6 7 3	25/-	20 9
Nigerian Elec.	£1	24/6		10	10	8 3 4	25/-	21 6
Palestine Elec. "A"	£1	17/6	+1/-	Nil	Nil	Nil	19/3	7 7
Perak Hydro-Elec.	£1	13 6		Nil	6	8 17 9	17/10	13 6
Equipment and Manufacturing								
Aberdare Cables	5/-	8/9	+3d	20	25	7 2 10*	8/9	7/4
Aerialite	1/-	12/-	+6d	88⅓	88⅓	7 7 3	11/6	8/1
Allen, W. H.	£1	50/-		15	15	6 0 0	51/-	42 10
Aron Elec. Ord.	£1	43/9		15	20	9 2 9	47/6	36/3
Assoc. Elec. Ord.	£1	43/9	+1/3	20	20	4 11 6*	45/7	36/4
Automatic Tel & El.	£1	65/-	+1/3	15	15	4 12 4	65/3	55/-
Babcock & Wilcox	£1	50/-		18	18	—	50/-	40/4
Baldwin, H. J.	2/-	4/9	+6d	20	20	8 8 6	4/1	3/-
Bakelite	10/-	25/6	+2/-	—	12½	4 18 0	24/9	16/-
British Aluminium	£1	37/-		12	12	6 9 8	43/10	35/-
B.I. Callender's	£1	39/3	+1/-	9	10	5 2 0	40/10	33/3
B.I. Callender's 6% Pref. ...	£1	25/-		6	6	4 16 0	26/3	23/-
British Thermostat	5/-	17/6		30	35	—	19/-	14/-
British Vac. Cleaner	5/-	12/6	+6d	25	25	10 0 0	16/6	11/-
Brook Motors	10/-	31/6		20	20*	6 7 0	37/-	27 10
Brush Ord.	5/-	4/-		10	4	—	5/4	2 11
A. F. Bulgin	1/-	3/3		30	30	9 4 6	3/5	2/6
Burco	5/-	12/9		35	35	6 17 3*	12/2	8/6
Chloride El. Storage	£1	48/3		15	20	4 3 0*	44/10	32/3
Clarke Chapman	£1	73/9	+1/3	15	17½	4 15 0	70/6	57/6
Cole, E. K.	5/-	23/9		25	25*	5 5 3	23/9	14/2
Cossor, A. C.	5/-	7/9	+6d	10	10	6 9 0	11/4	6/4
Crabtree	10/-	25/-	+6d	17½	17½	7 0 0	32/6	23/9
Crompton Parkinson Ord. ...	5/-	14/6	+3d	11¼	20	6 18 0	16/-	8/7
De La Rue	5/-	13/6	+1/-	35	Nil	Nil	14/6	6/3
Decca	5/-	37/6	+1/-	112½	150	4 1 0*	37/9	17/6
Desoutter	5/-	16/9		16	18	5 7 6	17/6	14/3
Dewhurst	2/-	6/3		19	19	6 1 6	6/9	5/-
Dictograph Tel.	2/-	5/6		20	20*	7 5 6	5/10	3/10
Dubilier Condenser	1/-	4/3		28	25*	5 17 9	4/4	2/10
E.M.I.	10/-	13/-	+1/3	12	8	6 3 0	15/3	11/6
Electrical Components	5/-	12/-		20	20	8 6 8	12/-	9/3
Elec. Construction	£1	53/9		15	15	5 11 9	56/-	50/6
Enfield Cable Ord.	£1	19/6	+1/6	7½	5	5 2 6	24/10	17/-
English Electric	£1	40/9	+1/-	15	15	—	40/8	34/-
English Electric 3½% Pref. ...	£1	16/-		3¾	3¾	4 13 9	16/4	14/6
Ericsson Tel.	5/-	48/-	+6d	22†	22†*	2 5 9*	48/9	36/-
Ever Ready	5/-	27/3		35	35	6 8 6	29/-	25/-
Falk Stadelmann	£1	38/3	+9d	15	15	7 16 10	44/3	38/3
G.E.C. Ord.	£1	40/-	+1/3	22½	11¼*	5 12 6	46/-	36/3
G.E.C. 6½% Pref.	£1	27/-		6½	6½	4 16 3	27/7	24/9
General Cables	5/-	16/9	+6d	30	30	8 19 2	17/-	14/9
Greenwood & Batley	£1	42/-	+3d	15	17½	8 6 9	41/6	38/-
Hackbridge Cable	5/-	11/9		20	20	8 10 3	13/-	10/4
Hackbridge & Hewittic	5/-	17/6		20	20	5 14 3	18/3	16/1
Hall Tel. Acc.	10/-	11/6	+6d	10	10	8 14 0	12/7	8/6
Heatrae	2/-	3/9		12½	12½	6 13 4	4/3	3/3
Henley's	10/-	16/9	+6d	20	10½*	6 5 5	19/4	16/-
Holophane	5/-	13/9		20	20	7 5 6	13/9	11/1

* After capital bonus. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

rescued the shares from the comparative depression which has affected them since the company's first decision regarding the future of the undertaking. It may be recalled that the £1 shares rose meteorically to over £6 at times last year, on the expectation that proceeds of the sale of the Venezuelan telephone subsidiary would be largely distributed. The price of the shares came down to £4¼ after a statement that the board's intention was, in fact, to retain the money for the purpose of continuing the business as an investment company. Following this, committees of shareholders were formed with the apparent object of securing for members, in one way or another, a share of the cash if they preferred not to stay with the company. Following reports that a workable plan on these lines has been worked out, the shares recovered a measure of their old form in rising 5s to £4¾.

in Electrical Investments

Company or Board	Nom. Value	Middle price 18th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1953 Highest	1953 Lowest
Equipment and Manufacturing—continued.								
Hoover	5/-	27/3	+6d	35	25	4 11 9	26/10	20/3
I.C.I.	£1	54/6	+1/-	13	13	4 15 5	54/-	41/6
Intl. Combustion	5/-	15/-	−6d	25	15*	5 0 0	15/6	12/1
Johnson & Phillips	£1	50/-		15	15	6 0 0	59/3	49/-
Lancashire Dynamo	£1	43/9		12½	12½	5 14 3	47/-	41/-
Laurence, Scott	5/-	13/9		15	15	5 9 0	14/6	11/9
Lister, R. A.	£1	32/-	+6d	9	9	5 12 6	34/3	27/9
London Elec. Wire	£1	38/6		12½	15	3 18 0	38/3	26/-
J. Lucas	£1	52/-	+9d	9½	10⅝	4 3 4	51/3	35/6
Marryat & Scott	2/-	5/3		22½	22½	8 11 6	6/3	5/1
Mather & Platt	£1	53/6		12½	15	5 12 3	53/10	41/3
Metal Industries	£1	41/6	−6d	15	12*	5 15 9	47/9	37/9
Midland Elec. Mfg.	£1	62/6		15	15	4 16 0	63/9	56/3
Morphy Richards	4/-	19/-	+2/9	40	40	8 8 6	16/3	13/-
Murex	£1	52/6		15	15	5 14 3	60/9	50/6
Newman Ind.	2/-	2/6		10	10	8 0 0	2/10	2/-
Oldham & Son	1/-	2/9		35	17½*	6 7 3	2/10	2/2
Parnall (Yate)	5/-	5/3	+6d	6	6	5 14 3	4/9	2/6
Parsons, C. A.	£1	38/3		10*	12½	—	48/-	27/9
Plessey	5/-	40/-		25	30	3 15 0	37/-	20/1
Pye Deferred	5/-	16/-		18	20	—	16/3	10/6
Revo	10/-	17/-		27½	27½	—	17/6	13/11
Reyrolle	£1	67/6		10*	12½	—	79/-	51/-
Rheostatic	4/-	11/-		16½	19	6 18 0	12/-	8/-
Richardsons Westgarth	5/-	9/3		12	15	8 2 3	11/1	8/6
Scottish Cable	4/-	13/3		32	20*	6 0 9	13/3	11/1
Siemens Ord.	£1	36/-	+1/-	10	10	5 11 0	37/-	31/6
S. Smith (England)	4/-	12/6		12½	15	4 16 0	12/6	7/11
Southern Areas	£1	18/6	−3d	5	6	6 9 9	19/7	10/3
Strand Elec.	5/-	8/-	+6d	17½	17½	10 18 10	10/-	7/9
Sturtevant	5/-	32/-	+2/-	17½†	18·1†*	—	29/9	20/10
Sun Elec.	£1	25/-		15	15	12 0 0	27/-	24/6
Switchgear & Cowans	5/-	12/6		22½	22½	9 0 0	16/9	12/6
Taylor, T.	5/-	12/3		20	25	5 2 0*	12/3	9/6
T.C.C.	10/-	42/6		20	20*	—	42/6	31/5
T.C. & M.	£1	31/6		10	8½*	5 8 0	31/6	25/6
Telephone Mfg.	5/-	7/6		10	10	6 13 3	9/4	7/1
Thorn Elec.	5/-	16/-	+2/6	12½	12½	3 18 3	14/-	7/10
Thornycroft	£1	35/9	+9d	15	15	8 7 8	54/-	29/9
Tube Investments	£1	63/3	+9d	15*	15	4 15 0	71/9	54/-
Vactric	5/-	8/9		Nil	Nil	Nil	10/3	3/6
Veritys	5/-	5/-		7½	10	10 0 0	5/4	4/1
Wallsall Conduits	4/-	45/-	+6d	70	70*	6 4 6	47/6	43/9
Ward & Goldstone	5/-	43/9	+1/3	45	45*	5 2 9	46/-	29/9
Watford	2/-	4/9		25	25	—	5/6	4/10
Westinghouse Brake	£1	63/9	+1/9	14	15	4 14 0	64/-	51/3
West, Allen	5/-	12/9		15	15	5 17 9	14/4	10/3
Wolf Electric	5/-	12/6	+1/6	—	15	6 0 0	12/8	9/6
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A Ord.	100	83½		—	6	7 3 9	91	77
Ord.	100	52½		—	3¾	7 2 10	57½	53
Anglo-Portuguese	£1	21/9		8	8	7 7 3	23/9	20/1
Brit. Elec. Traction:								
Def. Ord.	5/-	40/-	−6d	25	35	4 7 6	39/6	21/3
Cable & Wireless:								
Ord.	100	148	+2	8	8	5 8 1	148	124
4% Loan	100	97¼	+1	4	4	4 2 1	97¾	93
Calcutta Trams	£1	19/3		6†	2½†	—	23/6	16/-
Cape Elec. Trams	£1	13/-		5½	5½	8 9 3	13/-	9/-
Marconi Marine	£1	28/9		10	10	6 19 2	31/6	26/9
Oriental Tel. Ord.	£1	75/-		16	16	—	75/-	59/-
Telephone Props.	£1	4¾	+5/-	8	8	—	126/3	33/-
Telephone Rentals	5/-	9/6		10	10*	—	10/-	6/8

Radio Shares

Shares of the principal radio and TV manufacturers remain well in favour on the strength of the industry's latest sales and production figures. These indicated record amounts in November and the achievement, with a month to spare, of the production target of a million TV sets in 1953. Decca 5s shares remain the most active security in the list, and at 37s 6d are not far from their peak price. This company's accounts do not usually appear until the best part of a year after the closing of the books; the annual results, due shortly, will cover the twelve months ended last March. E.M.I. 10s shares have picked up well to 13s and good support has been forthcoming for, among others, Cossor, Ultra, J. & F. Stone and Thorn, the last named having risen from 13s 6d to 16s since the beginning of the month.

Radio Rentals

The 5s shares of Radio Rentals have moved up in striking style to their present price of around 44s 6d. They were quoted at 25s at one time last year, and were nearly 10s below to-day's level only a month ago, before the announcement of the annual results for the year ended in August. These revealed a further increase of 50 per cent in the net surplus, at £130,000, despite the incidence of a charge of no less than £104,000 for excess profits levy. Even after that impost, the earnings represent almost exactly 100 per cent gross on the ordinary capital of £227,000, on which the dividend is being raised with moderation from 35 to 45 per cent; the latter involves the distribution of less than £50,000 net. According to the report, the increase during the year in the number of subscribers was the largest in the company's experience, and there has been a further improvement since the close of the period. A yield of only 4½ per cent on the shares is evidently associated partly with the rate of the company's progression and partly with the recent demise of E.P.L.

Stock on Offer

With the supply of good stock tending to become limited, it may be of service to mention that a fairly substantial line of Crompton Parkinson 5s shares has been available lately at 14s 7½d, to yield over 6¾ per cent (on the basis of the 20 per cent distribution), which looks a generous return in relation to the general level of present

yields in the industrial market. Watford Electric 2s shares have also been offered in reasonable numbers at 5s, the indicated yield being 6¼ per cent, and Allen West 5s shares at 12s 10½d, to yield a little over 5¾ per cent. Scottish Cables 4s ordinary could be bought at 13s 3d and Telephone Manufacturing 5s at 7s 9d, the returns being respectively about 6 and 6½ per cent. Rheostatic 4s ordinary at the offered price of 11s 3d pay 6¾ per cent on the money, on the basis of the well-covered 19 per cent dividend.

Palestine Electric

Palestine Electric ordinary shares at around 17s 6d are now well above the depressed quotations of a year ago, but have responded with restraint to recent reports of new Israeli Government proposals. It appears that Government participation in some form is necessary to assure the raising of the new capital essential to the expansion of the undertaking. The plan finally agreed upon involves an offer by the Government to buy the 2,800,000 shares on the London register at a price of 29s 6d, payable in fifteen half-yearly instalments and bearing 4 per cent interest. Shareholders have gone without a dividend for the last two years, but new tariffs introduced a year ago were calculated to remedy the deficiency.

REPORTS and DIVIDENDS

Radio Rentals, Ltd.—The annual meeting will be held on 2nd February. In his circulated statement, Mr. H. F. Hunt (chairman) says that the increase in profit for the year under review was attributable mainly to the growth in the number of subscribers, which was greater than ever previously achieved in the history of the company. Public interest in television was considerably stimulated by the Coronation, and as a result business in the summer months was much heavier than could normally have been expected. Since the Coronation the demand has been steadily maintained. There has also been a satisfactory growth in the number of radio subscribers. All the subsidiary companies operated at a profit for the year, except Rentevision, Ltd., which has not commenced to trade.

British Industrial Plastics, Ltd., reports group profits for the year ended 30th September last of £441,987, as compared with £270,908 for the preceding year, and after providing for depreciation, etc., and £168,378 for taxation, there is a net profit of £104,120 (against £33,489), which with £7,027 tax unrequired, makes a total of £111,147 available, of which £108,789 is attributable to the parent company. It is proposed to pay a final ordinary dividend of 12½ per cent, making 20 per cent for the year (against 12½ per cent). The group carry-forward is £167,563, and the balance carried forward in the accounts of the parent company is £155,554.

Telephone Properties, Ltd.—S. G. Warburg & Co. have submitted to the board a plan for reorganization. Under the plan ordinary stockholders will be given the option either to retain their investment Telephone Properties, which would function as a general investment trust, or to participate, *pro rata* to their holdings, in the proceeds received from the realization of the company's assets. The plan is now under consideration by the board of Telephone Properties. A petition for the compulsory winding-up of Telephone Properties was adjourned on 11th January at the petitioner's request.

The directors on 14th January met a Stockholders' Committee led by Mr. S. R. Hogg and put forward certain proposals which they hoped would result in a scheme being evolved to meet the representations made. These proposals were accepted in principle by the Committee and it was agreed to hold a further meeting as soon as details had been worked out. The implementation of any scheme is, of course, dependent upon the outcome of the petition at present before the Courts.

Hackbridge Cable Holdings, Ltd., has announced an unchanged interim dividend of 7½ per cent.

The Cables Investment Trust, Ltd., has declared an interim dividend of 3 per cent (unchanged).

The Globe Telegraph & Trust Co., Ltd., is paying an interim dividend of 3 per cent (unchanged).

New Companies

Queensford Equipment Co., Ltd.—Registered 1st December. Capital £1,000. To enter into an agreement with R. R. C. Barlow of 369, High Road, Chiswick, W.4, for the purchase of all rights and other assets relating to the "Boston reversing switch," and to carry on the business of electrical, mechanical, power transmission and general engineers, etc. Directors: A. Champion and R. R. C. Barlow. Solicitors: Maxwell Batley & Co., 65, London Wall, E.C.2.

David Fisher (Blantyre), Ltd.—Registered in Edinburgh 18th December. Capital £100. Electrical engineers and contractors, etc. Directors: D. Fisher and D. Macdougall. Regd. office: 281, Glasgow Road, Blantyre.

Electrofact, Ltd.—Registered 21st December. Capital £2,000. Manufacturers, importers and exporters of and dealers in electric, electronic, magnetic, galvanic, pneumatic, nucleonic and chemical instruments and appliances, etc. Directors: P. J. Oranje, M. Buis and others to be appointed by the subscribers. Regd. office: Winchester House, Old Broad Street, E.C.2.

Cables and Equipment, Ltd.—Registered 4th January. Capital £100. Designers and manufacturers of and dealers in electrical apparatus of all kinds, etc. Directors: W. H. Burnet and A. G. Tearle. Regd. office: Ashtonville, Chalton, Beds.

Eltray Distributors, Ltd.—Registered 1st January. Capital £9,000. Mechanical, electrical and general engineers and consultants, etc. The first directors are to be appointed by the subscribers. Regd. office: 9/10, Tottenham Mews, W.1.

Hilton Electric Co., Ltd.—Registered 31st December. Capital £1,000. Manufacturers of and dealers in all kinds of electronic and electrical apparatus, etc. Directors: F. H. Colton and F. C. Hill. Solicitors: Hall, Pratt & Pritchard, Bilston.

Ferrier Television Service (Billingham), Ltd.—Registered 7th January. Capital £100. Hirers of and dealers in television sets, etc. Directors: F. G. Ferrier, Mrs. Dorothy H. Ferrier and C. B. Ingram. Regd. office: Regent House, South View, Billingham, Co. Durham.

Ferrier Television Service (Hartlepool), Ltd.—Registered 7th January. Capital £100. Regd. office: 44, Northgate, Hartlepool. Directors and other particulars are similar to Ferrier Television Service (Billingham), Ltd.

Ferrier Television Service (Wearside), Ltd.—Registered 7th January. Capital £100. Directors: F. G. Ferrier and Dorothy H. Ferrier. Regd. office: 7, Speculation Place, Washington, Co. Durham.

Increases of Capital

Donovan Electrical Co., Ltd.—Increased by £80,000, in £1 shares, beyond the registered capital of £120,000.

Electronic Laminations, Ltd.—Increased by £15,000, in £1 10 per cent redeemable cumulative preference shares, beyond the registered capital of £100.

Heddon-Smith & Co., Ltd.—Increased by £2,500, in £1 4 per cent redeemable preference shares, beyond the registered capital of £10,000.

Bankruptcies

L. F. Kent, 32, High Street, Broadstairs, Kent, radio and electrical engineer. —Second and final dividend of 6s 7¾d in the £, payable on and after 29th January at the Official Receiver's Office, 1, The Parade, Canterbury.

N. Lusher, formerly of 15, Cheltenham Parade, and 11a, Dragon Parade, Harrogate, and who now has premises at the back of 18b, Oxford Street, Harrogate, electrician. —Public examination 26th February at the Court House, Raglan Street, Harrogate.

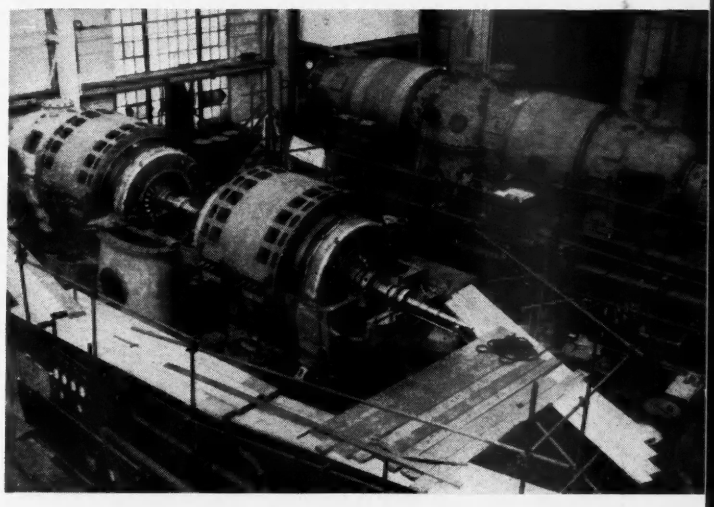
A. F. Ayers, 104, Bridgewater Drive, Westcliff-on-Sea, Essex, electrical contractor.—Public examination 25th March at 102, Alexandra Road, Southend-on-Sea.

F. E. Thorne, electrician, 44, Cranhurst Road, Cricklewood, London, N.W.2.—Trustee, Mr. D. H. Pexton, 107, Jermyn Street, London, S.W.1, appointed 31st December.

J. Robertson, 68, Arran Road, Canford, London, electrical engineer.—Supplemental dividend of 3s 10½d in the £, payable at the Official Receiver's office, 58–61, York Terrace, Regent's Park, N.W.1.

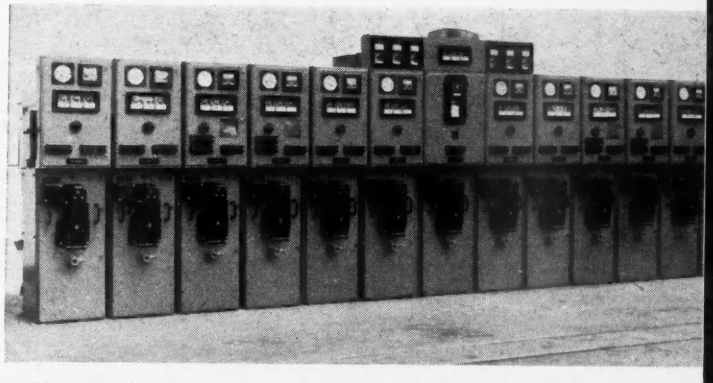
Electrical Manufacturing 1953

Brush Electrical Engineering Co., Ltd.



Two 12,500 kW sets for Lagos under construction

Cubicle type switchboard with type VC5 metalclad compound filled switchgear for installation in India



DURING the past year the Brush Electrical Engineering Co., Ltd., has reorganized or extended sections of its works to meet the production drive for a greater output to meet world demands for quicker delivery. In connection with turbine production, a new machine has been installed to improve the capacity and facilities for balancing and overspeeding alternator rotors and for balancing at machine speeds the combined alternator rotor and overhung blade systems of Brush-Ljungström turbo-alternator sets.

The switchgear production department has been enlarged to double the previous capacity of this product. The equipment made includes metalclad units for voltages up to 15 kV and with breaking capacities up to 350 MVA; outdoor circuit breakers for 33 kV service with a breaking capacity rating of 1,000 MVA; and for l.v. systems a range of industrial pattern circuit breakers and high breaking capacity fuse-switchgear, together with special control gear for traction and marine services.

The company's new laboratories now have seven main divisions, each equipped with the most up-to-date facilities for systematic investigation and research.

In the electric machine division, testing facilities have been reorganized, and new equipment has been installed for testing large engine driven alternators and d.c. motors and generators. Equipment has been developed for use in the winding shop for inspecting and testing the insulation at various stages with resulting improvements in design and manufacture of all types of machines. Particular advances have been made in inter-turn testing of coils and the insulation of alternators.

During the year, attention has been directed towards the perfection of the Brush "Amplidex" system of control, particularly for engine driven alternators. The successful completion of this development has resulted in the production of a range of alternators with close voltage regulation, which is maintained under varying ambient and loading conditions. The alternators are all of orthodox construction, and this, allied to the simple method of voltage control, ensures satisfactory performance.

In the turbine section the dispatches include two 8,750 kW sets for Bangkok, a 12,500 kW set installed at Kingston, Jamaica, and two 12,500 kW sets for Lagos, Nigeria. In addition a range of condensing and back pressure axial flow machines have been completed and shipped. Repeat orders have been received from Mauritius, Australia and this country for this type of turbine.

In the transformer section important orders have been received from sterling and dollar areas, and the previous high level of exports to Canada has been maintained. Repeat orders have been received from South Africa, among them four 20 MVA units with on-load tap changing gear for Pretoria Municipality and a number of 2,500 kVA, 88 kV units for the Electricity Supply Commission's Rand undertaking. For the extension to the Kelvin power station, Johannesburg, three 40 MVA, 88 kV water cooled units together with two 8 MVA, three 4 MVA and fifteen 750 kVA transformers are being supplied.

Middle East electrification scheme requirements are being met, notably at the Aden Refinery project where Brush are supplying a 6 MVA transformer and at Bahrein where the Government Electricity Department has ordered two 5 MVA and two 3·75 MVA units together with a number of smaller distribution transformers. Paper and paper pulp mills have figured in the industrial side of electrical supply: twenty 1,000 kVA transformers have been ordered by the Tasman Pulp and Paper Co., Ltd., Auckland, New Zealand, and at home five 2 MVA and two 4·5 MVA units are being produced for the Bowater Corporation. Eleven 10 MVA transformers with on-load tap changing gear have been ordered by home Electricity Boards, as well as repeat orders for distribution sizes.

The company's range of flameproof motors has been extended up to 150 h.p. and is available, either squirrel-cage or slip-ring, at 400 to 600 V or 3·3 kV, 1,000 r.p.m.

Orders for motors have been maintained at a good level

and contracts have also been secured for many alternators of outputs between 1,500 and 2,000 kW, most of them being for 11 kV. There have also been orders from the B.E.A. for complete diesel generating plants, through the associated companies, with h.v. alternators having outputs up to 2,000 kW.

At the Cardiff Works, a complete range of totally enclosed fan-cooled squirrel-cage motors to British Standard dimensions have been developed and production has commenced. The "square path" alternator introduced in 1952 which has self-regulating features and is built in various sizes from 1 to 35 kVA has been well received and a large number have been sent overseas. Many vertical spindle hollow shaft motors have been exported for use in tubewells, and a standardized control unit has been developed to suit this application.

Resulting from the extension of the switchgear department, there has been a substantial output of metalclad switch units for overseas, in the range of 150 to 250 MVA up to 11 kV, and for the United Kingdom much of this gear has been supplied for primary industries such as steelworks and coal mining. Outdoor type oil circuit breakers for up to 33 kV and 1,000 MVA breaking capacity are in regular production, and orders for a substantial number were secured.

The general engineering division is responsible for handling comprehensive power schemes of all kinds. The past year has proved a busy one with particular reference to complete diesel-electric generating stations for the Persian Gulf area and elsewhere, together with complete turbo-electric projects in connection with cement plants in various parts of the world. In addition, turbo-electric and diesel-electric power schemes, including the supply of switchgear, transformers, cabling, lighting, etc., together with distribution substations for municipal undertakings have been arranged.

Television Advisory Report

THE second report of the 1952 Television Advisory Committee (chairman, Admiral Sir Charles Daniel, K.C.B., C.B.E., D.S.O.), has been published this week (H.M. Stationery Office, London, price 1s net). It mainly relates to the recommendations of the Technical Sub-Committee (chairman, Dr. W. G. Radley, C.B.E., Ph.D.(Eng.), M.I.E.E., Engineer-in-Chief, G.P.O.) which was last year requested to examine the relative merits of amplitude and frequency modulation for very high frequency (v.h.f.) sound broadcasting. It is recommended that frequency modulation should be used for v.h.f. sound broadcasting in this country. This recommendation holds good whether sufficient v.h.f. stations are eventually put up to give a national coverage of three programmes, or whether the number is sufficient only to provide a substantial reinforcement of the services now given on long and medium waves. But it does not necessarily apply if the development of v.h.f. sound broadcasting is restricted to a small number of low-power stations. It is felt that if only a small number of stations were authorized now the possibility of a subsequent increase ought to be taken into account, and that the system of modulation to be used from the outset should be that suitable for a large number of stations.

The introduction of v.h.f. sound broadcasting is an unwelcome complication. It is, however, the only means of overcoming the difficulties which arise from the shortage of medium wavelengths and increasing interference from Continental broadcasting stations, and sound programmes will certainly be required for a long time ahead. If v.h.f. sound broadcasting has to be introduced it is best done on a fair scale, because receiver production on a limited scale is undesirable from the point of view of the radio industry. Moreover, a good home market is an important help to the export trade.

The proposal that v.h.f. sound broadcasting in this country should take place in the range 88–95 Mc/s has been noted and the use of the band for this purpose is endorsed. It is considered that this allocation will not impair television development provided the specific recommendations contained in the Committee's first report of 8th May, 1953, are implemented.

N.E.S.C.O.E. Reunion

THE sixteenth annual dinner of the N.E.S.C.O.E. Association (North Eastern Electricity Supply Company's Old Employees) was held in London on 14th January under the chairmanship of its president, Sir Arnold B. Gridley, M.P.

The toast of the Association was proposed by Mr. L. W. Joynson Hicks (Parliamentary Secretary, Ministry of Fuel and Power), who referred to the great part played by its members in the development of the electricity supply industry. He had been informed by Sir John Hacking that electricity was cheaper in this country than anywhere else. Thanks to the mild winter, the coal position was not at present causing so much concern as usual. He commended the keeping-together spirit of the Association, which had built up prestige and was an inspiration for the future.

In response, the chairman, speaking from more than half a century's experience in the electrical industry, said that while the former company had been justifiably proud of the service it had rendered to its consumers, its ex-members, irrespective of any political views, wished the nationalized organization every possible success in continuing the same quality of service. In this connection he paid a tribute to the late Mr. R. P. Sloan, his predecessor as president. Plant was still lamentably short, but they appreciated the efforts of the manufacturers to improve the position.

Proposing "Our Guests," Sir John Hacking mentioned especially Mr. W. Robson-Brown, M.P. (Esher Division of Surrey) and Mr. W. K. Brasher, secretary of the Institution of Electrical Engineers. He recalled Mr. Robson-Brown's flying record in the R.F.C. in the first world war and later in the R.A.F., and his subsequent recognition as an authority on labour relations. Sir John agreed with Sir Arnold about the unsatisfactory plant position and the happy relations established with manufacturers.

Responding, Mr Robson-Brown expressed his pleasure at being invited by Mr. E. R. Wilkinson to be present, as he himself was a North East Coast man and was educated at Armstrong College. He had had the privilege of working with Sir Charles Parsons—a most human and understanding person. He also referred to the high esteem enjoyed by Sir Arnold Gridley in Parliament.

The proceedings ended with expressions of thanks by the chairman to Mr. S. Pike for his work as honorary secretary of the Association, and by Col. E. H. E. Woodward to the chairman.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 3rd March from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1949

27271. British Thomson-Houston Co., Ltd. —High-pressure electric discharge devices. 24th October, 1949. (704848.)

28200. General Electric Co., Ltd., and Dunham, C. R.—Means for indicating reversal or other fluctuations of electric current. 3rd November, 1950. (704746.)

1950

4039. Siemens & Halske Akt.-Ges.—Metering circuits of telephone systems. 16th February, 1950. (704749.)

4677. Hoover, Ltd., and Camprubi, B.—Commutators for dynamo-electric machines. 16th February, 1951. (704948.)

5249. Electric & Musical Industries, Ltd.—Piezo-electric pick-ups. 23rd February, 1951. (704750.)

8756. Soc. Jacquet-Hispano Suiza.—Electrolytes and methods for electro-polishing and electro-deburring. 6th April, 1950. (704945.)

9617. General Electric Co., Ltd., and Cook, K. G.—Electric control and indicating apparatus comprising discharge tubes. 18th July, 1951. (704752.)

9618. General Electric Co., Ltd., and Holliday, J. H.—Electric control and indicating means comprising electric discharge tubes. 18th July, 1951. (704753.)

10967. Parsons & Co., Ltd., C. A., and Kolb, P.—Sealing arrangements for rotary type regenerative heat-exchangers. 20th April, 1951. (704857.)

11928. Grigsby-Allison Co., Inc.—Rotary electrical switches. 12th May, 1950. (704951.)

13034. British Tabulating Machine Co., Ltd.—Electromagnetic relay circuits. 21st March, 1951. (704860.)

16571. Ever Ready Co. (Great Britain), Ltd.—Processes of electrolytic polishing of metals. 9th July, 1951. (704953.)

16644. Western Electric Co., Inc.—Rectifier-type power supply systems. 4th July, 1950. (704864.)

16744. Speroni, G.—Method of distributing telephone lines. 5th July, 1950. (704759.)

24861. National Research Development Corporation.—Electric switches required to operate when an applied force reaches a predetermined magnitude. 19th December, 1951. (704957.)

26692. Wiggin & Co., Ltd., H.—Electric induction furnaces. 1st November, 1951. (704960.)

28853. Film Cooling Towers (1925), Ltd., Branczik, K. W., and Branczik, E. A. C.—Water-cooling towers. 16th November, 1951. (704965.)

30532. British Thomson-Houston Co., Ltd. —Electric motor control systems for winding engines and the like. 22nd August, 1951. (704875.)

1951

243. Standard Telephones & Cables, Ltd.—Gaseous-electric discharge tubes. 3rd January, 1951. (704968.)

351. Gamble, H.—Device for the removal of electrostatic charges on paper sheets during folding operations. 4th January, 1952. (704870.)

1845. Metropolitan-Vickers Electrical Co., Ltd.—Electrical indicating devices for surge diverters. 16th January, 1952. (704877.)

1869. Siemens & Halske Akt.-Ges.—Cathode-ray oscillographs. 24th January, 1951. (704878.)

3269. Tecalemit Soc. Anon.—Electrically insulating packing for railway tracks. 9th February, 1951. (704973.)

4481. Booth, S.—Overload protection of electric motors. 22nd November, 1951. (704977.)

6073. Compagnie Générale de Télégraphie sans Fil.—Magnetrons. 13th March, 1951. (704979.)

7008. Electric & Musical Industries, Ltd.—Ganged tuning arrangements for radio and like circuits. 18th March, 1952. (704982.)

7734. Evershed & Vignoles, Ltd.—Apparatus for testing electrical control systems. 26th March, 1952. (704883.)

8423. Evershed & Vignoles, Ltd.—Electrical controlling apparatus. 26th March, 1952. (704885.)

15363. Standard Telephones & Cables, Ltd. —Multi-gap electric discharge tubes and circuit arrangements therefor. 28th June, 1951. (704997.)

15658. McGraw Electric Co.—Automatic reclosing electric circuit breakers. 2nd July, 1951. (704893.)

15659. McGraw Electric Co.—Automatic reclosing electric circuit interrupters. 2nd July, 1951. (704894.)

16331 & 16333. Philips Electrical Industries, Ltd.—Circuits comprising electric discharge tubes of the electron-beam type. 10th July, 1951. (704998 & 704875.)

16504. Electric & Musical Industries, Ltd.—Synchronizing circuit arrangements for electric oscillation generators. 19th June, 1952. (704897.)

16822. British Thomson-Houston Co., Ltd. Frequency-interlace colour television systems. 16th July, 1951. (704791.)

18115. Pittsburgh Plate Glass Co.—Method of producing an electro-conductive article. 31st July, 1951. (704793.)

19106. Wiener Isolierrohr-, Batterie- und Metallwarenfabrik Ges.—Air depolarized electric dry cell and electrolyte therefor. 14th August, 1951. (704904.)

20285. Cooney, J. R.—Carrier-current intercommunication apparatus. 28th August, 1951. (705023.)

20312. Philips Electrical Industries, Ltd.— Preparation of fluorescent tungstates. 24th July, 1952. (705024.)

23074. Meopta Narodni Podnik, and Hampl, J.—Apparatus for recording and reproducing sound. 3rd October, 1951. Addition to 673275. (704798.)

23245. Western Electric Co., Inc.—Semiconductor electric signal translating devices. 5th October, 1951. (704912.)

24379. Metropolitan-Vickers Electrical Co., Ltd.—Fluid valves and taps. 11th August, 1952. (704913.)

24853. Kampnagel Akt.-Ges. (Vorm. Nagel & Kaemp).—Electric motor provided with a brake. 24th October, 1951. (704914.)

24986. British Thomson-Houston Co., Ltd. —High definition television systems and methods. 25th October, 1951. (704803.)

—25146. Telefonaktiebolaget L. M. Ericsson. Sound carriers for magnetic recording and reproducing machines. 26th October, 1951. (704806.)

25933. Philips Electrical Industries, Ltd.— Devices for producing calibrating pulses. 6th November, 1951. (704808.)

26028. Dynamatic Corporation.—Control of eddy-current couplings. 7th November, 1951. (705035.)

26270. Heinrich, R. F.—Electrostatic precipitators. 9th November, 1951. (705036.)

28424. British Thomson-Houston Co., Ltd. —Laminated magnetic cores. 4th December, 1951. (704917.)

29484. British Thomson-Houston Co., Ltd. —Electronic impulse counters. 12th November, 1952. (704816.)

1952

320. Donaldson, D.—Stand for heating an electric hand iron. 2nd January, 1953. (704921.)

4406. Radio Corporation of America.— Metal cones for cathode-ray tubes. 19th February, 1952. (705007.)

4729. Standard Telephones & Cables, Ltd. —Voice frequency signal receivers. 22nd February, 1952. (704922.)

5513. British Thomson-Houston Co., Ltd. —Dynamo-electric machines. 3rd March, 1952. (705010.)

6740. Krupp Elektrowerkstätten, F.— Charging device for accumulators. 14th March, 1952. Addition to 683187. (704926.)

7211. Compagnie des Freins et Signaux Westinghouse.—Photo-electric cells. 20th March, 1952. (704828.)

7476. Mitchell, F.—Electrical interrupter. 24th March, 1952. (704927.)

7528. Vyzkumny Ustav Tezkeho Strojirenstvi, and Houst, F.—Apparatus for the decomposition of gas by electric arcs. 24th March, 1952. (705011.)

9396. Smith & Sons (England), Ltd., S., and Furzehill Laboratories, Ltd.—Arrangements for altering the phase of the modulation of amplitude-modulated a.c. signals. 15th April, 1952. (704929.)

13606. Telefonaktiebolaget L. M. Ericsson. —Device for the generation of electrical pulses. 28th May, 1952. (705042.)

15459. Philips Electrical Industries, Ltd.— Electric-discharge tubes. 19th June, 1952. (705044.)

18102. General Electric Co.—Dynamo-electric machines. 17th July, 1952. (705047.)

1953

2724. Western Electric Co., Inc.—Rectifier power supply systems. 4th July, 1950. Divided out of 704864. (704940.)

Resignalling of Stanmore Branch

WORK is to start this year on a scheme to reduce delays on the Bakerloo Line by resignalling the four-mile section between Wembley Park and Stanmore. The signalling, now over twenty years old, is to be replaced to permit a two-minute headway, which will result in improved regularity of running throughout the whole of the Central Section of the Bakerloo Line. The work coincides with the provision of additional tracks to ease the bottleneck north of Wembley Park where Bakerloo trains now share tracks with Metropolitan stopping trains. Some 70 miles of wiring will be installed in connection with the new signalling works, the total cost of which will be about £78,000.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 231, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 25th January

BIRMINGHAM.—James Watt Memorial Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Radio Group. "A Method for the Synthesis of Speech," by W. Lawrence. (Joint meeting with the Birmingham Centre of the Institution of Post Office Electrical Engineers.)

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 7 p.m. I.E.E. Western Utilization Group. "Cables in Industry with particular reference to Aluminium Sheathed Cables," by G. H. Bowden.

HANLEY.—Grand Hotel. I.E.S. Stoke-on-Trent Group. Annual dinner.

LEEDS.—24, Aire Street, 6.15 p.m. I.E.S. Leeds Centre. "The Effect of Light on the Growth and Development of Plants," by Miss D. Vince.

The University, 7.30 p.m. Incorporated Plant Engineers, West & East Yorks Branch. Film show.

LEICESTER.—E.M.E.B. Charles Street, 7.30 p.m. I.E.S. Leicester Centre. "Signs and Display Lighting," by C. Higgins.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio Section. Discussion on "Should Sound Broadcasting of the Future be entirely in the V.H.F. Band?" opened by Dr. A. J. Biggs.

MANCHESTER.—Engineers' Club, Albert Square, 7.30 p.m. Junior Institution of Engineers, North Western Section. "Flour Milling Plant," by L. T. Ansley.

NEWCASTLE-UPON-TYNE.—At the Literary and Philosophical Society, 6.15 p.m. I.E.E. North-Eastern Centre. "Continuity of Electricity Supply," by H. Leyburn (Parsons Memorial Lecture).

READING.—George Hotel, 7.15 p.m. I.E.E. Reading district meeting. "Training on Electronic Fire Control in R.E.M.E.," by Capt. R. A. Middleton.

Tuesday, 26th January

BRADFORD.—Y.E.B. Sunbridge Road, 6.30 p.m. I.E.E. North Midland Students' Section. "An Introduction to Electrical Images," by P. S. Kharas.

HUDDERSFIELD.—Technical College, Queen Street South, 6.30 p.m. I.E.E. North Midland Centre. Discussion on "The Teaching of Electrostatics," opened by S. Barnett.

LONDON.—At the Institution of Electrical Engineers, Savoy Place, 6.30 p.m. Electrical Association for Women. Caroline Haslett Trust Lecture, by Miss E. J. Sharp.

2, Savoy Hill, W.C.2, 6 p.m. Illuminating Engineering Society. Discussion on "Design of Lighting Fittings," opened by M. Black, G. Baines, M. Hawkins and L. A. Phillips.

Manson House, Portland Place, W.1, 7 p.m. Society of Instrument Technology. "Discussion on Kinematic Design," opened by Dr. H. J. Braddick.

At the Institution of Mechanical Engineers, Storey's Gate, 5.30 p.m. Institute of Fuel, London meeting. "Refractory Recuperators," by F. H. Cass, Dr. N. L. Franklin and Prof. A. L. Roberts.

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Measurements Group. "Alternating-Current-Instrument Testing Equipment," by Dr. A. H. M. Arnold.

WOLVERHAMPTON.—Technical College, 7.15 p.m. British Institution of Radio Engineers, West Midlands Section. "Microwave Measuring Instruments," P. M. Ratcliffe.

Tuesday, 26th to Friday, 29th January

LONDON.—At the Royal Empire Society, Craven Street, W.C.2. Annual Conference of Electrical Housecraft Advisers and Senior Demonstrators (28th January at Olympia; 29th January at the Connaught Rooms).

Wednesday, 27th January

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. "Service Experience of the Effect of Corrosion on Steel-Cored Aluminium Overhead-Line Conductors," by Dr. J. S. Forrest and J. M. Ward.

Grosvenor House, W.1, 6.30 for 7 p.m. Electrical Contractors' Association. Annual dinner.

TORQUAY.—Electric Hall, 3 p.m. I.E.E. South-Western Sub-Centre. "Electronic Telephone Exchanges," by T. H. Flowers.

Thursday, 28th January

BIRMINGHAM.—Grand Hotel, 7 for 7.30 p.m. Institute of Metal Finishing, Midland Branch. Annual dinner-dance.

GLOUCESTER.—Technical College. I.E.E. Bristol Students' Section. "Electronic Organs—How they Work," by T. G. Flynn.

RUGBY.—The Laurels Club, Dunchurch Road, 7.30 p.m. I.E.E. Rugby Students' Section. Film evening.

SHEFFIELD.—Grand Hotel, 7.30 p.m. Incorporated Plant Engineers, Sheffield & District Branch. "Planned Maintenance," by O. F. Lewis.

WORCESTER.—Works Institute, Hylton Road Power Station, 7.15 p.m. I.E.E. South Midland Centre, District meeting. "The Royal Festival Hall: Electrical Installations," by J. G. Hunter.

Friday, 29th January

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 6 p.m. I.E.S. Birmingham Centre. "Lighting for Sport," by M. W. Peirce.

Imperial Hotel, 7.30 p.m. Incorporated Plant Engineers, Birmingham Branch. "Hydraulics," by W. R. Groves.

BRIGHTON.—Grand Hotel. E.I.B.A. Sussex Centre. Annual ball.

BRISTOL.—S.W.E.B. Colston Avenue, 6.15 p.m. I.E.S. Bath and Bristol Centre. "The Lighting of Docks and Railway Marshalling Yards," by W. T. F. Souter.

LONDON.—Storey's Gate, St. James's Park, S.W.1, 5.30 p.m. Institution of Mechanical Engineers. "Some Model Experiments on Special Control Valves," by D. Firth and L. Young.

NEWCASTLE-UPON-TYNE.—King's College, 6.30 p.m. I.E.E. North Eastern Students' Section. Students' lecture. "Electrical Safety Precautions," by H. W. Swann.

Royal Turk's Head Hotel. I.E.S. Newcastle Centre. Dinner-dance.

SHEFFIELD.—Grand Hotel, 6.30 p.m. Institute of Metal Finishing, Sheffield and North-East Branch. "Rectifiers and Plating Shop Power Supplies," by I. T. Watkins.

Saturday, 30th January

LONDON.—I.E.E. London Students' Section. Visit to Queen Mary College, High-Voltage Laboratory, Mile End Road, E.1, at 10.30 a.m.

ILLUMINATING ENGINEERING SOCIETY

AT the Summer Meeting of the Illuminating Engineering Society which will be held at Southport from 18th to 21st May, the following papers will be presented:—

"Lamps and their Uses," by J. N. Aldington, B.Sc., Ph.D., F.I.E.S., discussing the factors underlying the evolution of practical lamps and their properties and characteristics, and describing the relation between these properties and modern lighting techniques; "Street Lighting in a London Suburb," by A. T. Durbridge, showing how the Harrow Urban District Council (Middlesex) was faced with the much overdue task of providing an efficient and modern public lighting installation throughout its area, and the method adopted by the local authority in solving the problem; "The Decorative Approach to Commercial Lighting," by André Claude, demonstrating that the essence of decorative lighting is the production of æsthetic effects, bearing in mind the universal laws of beauty and of visual sensations; "Home Lighting," by Arthur H. Young and C. J. Misselbrook, B.Sc. (Eng.), F.I.E.S., dealing with the relation between the development of lighting design, architecture and interior decoration during recent years and discussing present-day trends at home and overseas; and "Lighting for Plant Growth," by A. E. Canham, M.Sc., in which such effects of light as growth and development will be discussed.

There will also be four short papers on the economics of different types of industrial lighting installations as follows:—A hot cathode installation, by S. T. Clarke, a cold cathode installation, by W. Howe, a high bay mercury installation, by F. Jones, and a blended light installation, by G. W. S. Levey.

The programme of the meeting also includes a display of new lighting equipment and a number of educational and technical visits. The registration fee for the meeting will be £1 for members and 10s for ladies. For those unable to attend for the full period of the meeting the fee will be 10s a day for members and 5s a day for ladies. For non-members the fee will be £2 for the whole meeting or £1 for single days. Particulars are available from the Secretary, I.E.S., 32, Victoria Street, London, S.W.1.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—BRISBANE.—12th February. City Council. Maximum demand indicators. (E.S.B. 13313/53. Ten/8005.)*

Banbridge.—6th February. R.D.C. Electric wiring for thirty-six houses in the townships of Kinallen (12), Moneyslane (12), and Shanaghan (12). F. N. Miller, Clerk to the Council, Council Offices, Linenhall Street, Banbridge, Co. Down.

Bath.—9th February. City Council. Automobile batteries and lamps; l.v. cables; electric discharge lamps, control gear and fittings; tungsten lamps and electrical fittings; lanterns for street lighting (Groups A and B); and time switches for street lighting, for one year from 1st April next. City and waterworks engineer, Guildhall.

Belfast.—12th February. Electricity Department. Street lighting equipment. (See this issue.)

4th February. Electrical installation in Park Parade School meals kitchen, Ravenhill Road, Education Architect's Department, Education Offices, Academy Street.

Bletchley.—26th January. U.D.C. Prepayment meters. (See this issue.)

Brazil.—PORTO ALEGRE.—5th February. Commissao Estadual de Energia Electrica. Electricity meters. (E.S.B. 588/54. Ten/8048.)*

16th March. Comissao Estadual de Energia Eletrica. Transformer substation equipment. (E.S.B 1023/54. Ten/8066.)*

Cannock.—9th February. U.D.C. Street lighting equipment and fittings for one year. Forms from E. Lomax, surveyor, Council Offices, The Green.

Carlisle.—30th January. City Council. Electrical installations in new flats at the former isolation hospital. Plans by L. J. A. Stow, city engineer, 18, Fisher Street.

Durham.—1st February. County Education Committee. Electrical installation at Springwell County School. Plans by G. R. Clayton, county architect, Court Lane, Durham.

Gillingham (Kent).—1st February. Town Council. Switches and accessories, conduit and accessories, wire, cables and accessories, and electric lamps, for one year. Borough surveyor, Municipal Buildings.

Great Yarmouth.—1st April. Corporation. Cables for one year from 1st April. (See this issue.)

Greece.—ATHENS. — 28th January. Greek Social Insurance Institute. Eight electrically-operated lifts. (E.S.B. 979/54. Ten/8067).*

Huyton-with-Roby. — 30th January. U.D.C. Public lighting equipment, electric cables and flexibles, and electrical sundries for one year. Surveyor, Council Offices, Derby Road.

India.—NEW DELHI.—2nd February. Director General of Supplies and Disposals. Electric cable. (E.S.B. 363/54. Ten/8025.)*

TRIVANDRUM.—17th February. Secretary, Stores Purchase Committee. Underground cable boxes. (E.S.B. 529/54. Ten/8044.)*

Iran.—TEHRAN.—28th February. Procurement Officer, c/o American Embassy. Refrigeration equipment in the port of Khorramshahr. (E.S.B. 13136/53. Ten/8014.)*

London.—11th February. Metropolitan Water Board. Electric lamps for one year. Chief engineer, Room 171, New River Head, Rosebery Avenue, E.C.1.

19th February. India Store Department. Relay board for electrical engineering laboratory. (See this issue.)

Mitcham. — 6th February. Town Council. Electric lamps for one year. Borough engineer, Town Hall.

Salford.—2nd February. Corporation. Stores, including street lighting equipment for one year from 1st April. (See this issue.)

South Africa.—PRETORIA.—4th February. Union Tender and Supplies Board. 20 kW generating set. (E.S.B. 1022/54. Ten/8072).*

South West Africa.—WINDHOEK.—29th January. South West Africa Tender Board. 100 electric hot-water cylinders. (E.S.B. 337/54. Ten/8022.)*

Southern Rhodesia.—CAUSEWAY.—29th January. Tender Board. X-ray plant and accessories. (E.S.B. 631/54. Ten/8036.)*

United States.—WENATCHEE, WASHINGTON.—3rd February. Public Utility District No. 1 of Chelan County. Automatic h.v. voltage regulators. (E.S.B. 98/54. Ten/8047.)*

DENVER, COLORADO.—18th February. Bureau of Reclamation. One 30,000/40,000 kVA and two 6,000/7,500 kVA autotransformers. (E.S.B. 736/54. Ten/8080.)*

Uruguay.—MONTEVIDEO.—17th February. Administracion de Ferrocarriles del Estado. Alkaline batteries and electrolyte. (E.S.B. 13509/53. Ten/8011.)*

ORDERS PLACED

Chelmsford.—Corporation. Recommended. Street lighting on three housing estates and on the Widford Industrial Estate (£3,002).—Erecon, Ltd.

Liverpool. — Housing Committee. Electric lighting to replace the existing gas lighting of certain public landings and staircases in various flats in the central areas (£1,941).—Merseyside and North Wales Electricity Board.

London.—L.C.C. Broadcasting equipment for comprehensive schools (£8,569).—Clarke & Smith Manufacturing Co.

Oldbury.—Town Council. Provisionally accepted. Erection of 212 street-lighting columns on certain bus routes. (£7,558).—Midlands Electricity Board.

Ripon.—City Council. Lamp standards and equipment in connection with a street lighting scheme for North Road (£2,112).—Revo Electric Co., Ltd.

Salford.—Baths and Washhouses Committee. Installation of call bell systems in the slipper baths at the Seedley, Regent Road and Pendleton Baths and the Hodge Lane Public Wash-house (£1,111).—North Western Electricity Board.

Sheffield. — Housing Committee. Electrical installations in 269 dwellings on the Greenhill–Bradway Estate (£4,489).—Hall & Stinson, Ltd. Electrical installations in 477 dwellings on the same estate (£10,043).—A. Holmes.

Tottenham.—Highways and Works Committee. Various public lighting schemes (£9,315).—Engineering & Lighting Equipment Co., Ltd.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section in no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Accrington.—Flats (84), Burnley Road estate; Gregory Flats, Ltd., Chapel Street, Worthing.

Anstey.—Sir Robert Martin Secondary School; T. A. Collins, architect, 123, London Road, Leicester.

Barnard Castle.—Houses (40) and two shops and flats on the Green Lane estate; North-Eastern Housing Association, Northumberland Road, Newcastle-on-Tyne.

Barnes.—Flats (72), Priests Bridge site; borough surveyor.

Barnsley.—Secondary modern school at Athersley estate; V. Dunk, Ltd., 12, Grafton Street.

Birmingham. — Greston Infants' School; J. R. Deacon, Ltd., Lombard Street, Lichfield.

Blackburn.—Crematorium and chapel at Pleasington Cemetery; borough engineer, Town Hall.

Brigg. — Secondary modern school (£110,655 including equipment); county architect, Council Offices, Lincoln.

Cannock.—Factory adjoining trunk road A5 at Bridgtown; Hardy Spicer & Co., Ltd., Birch Road, Birmingham, 6.

Canterbury.—Dwellings (104), Whitehall Road; city architect.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Chester.—Highfield Junior School, Blacon; city surveyor.

Chesterfield.—Extensions at Hollywell Street, for Kennings, Ltd.; F. W. Tempest, architect, Regent Street, Mansfield.

Coventry.—Central police headquarters (£300,000); D. E. E. Gibson, city architect, Bull Yard, off Warwick Row.

Cranham (Essex). — Houses and bungalows (129), Oaks estate; Academy Electric Building Co. (1931), Ltd., Burges Road, London, E.6.

Croydon.—Factory, Vulcan Way; E. F. Langdale, manufacturing chemists, 24, St. Cross Street, London, E.C.1.

Darlington.—Personnel block for Whessoe, Ltd. (£18,000); Bovis, Ltd., builders, London, W.1. Pickling shop, 405ft long and 62ft wide; company's own architects.

Dunstable.—Works; Hayward-Tyler & Co., Ltd., Crawley Green Road, Luton.

Durham.—New schools at Consett, Newton Aycliffe and Peterlee and alterations to Spennymoor Whitworth House Day School; county architect, Court Lane, Durham.

Edmonton.—Factory, Eley's estate; Donaldson & Son, 17, Dalston Lane, E.8.

Gateshead.—Six new factories and additions to 13 others at Gateshead for North-Eastern Trading Estates, Ltd., Team Valley.

Gosport.—Warehouse, North Street; E. H. Smith & Son, waste paper merchants, 38, Blake Road.

Halesowen.—Works extensions; Tube Manipulations, Ltd., Masters Lane.

Halifax. — Bus station, Crossfield; borough engineer.

Hartlepool.—E.N.T. ward unit at Hartlepools Hospital for Newcastle Hospital Board, "Dunira," Osborne Road, Newcastle-on-Tyne; Board's chief architect.

Houses for T.C.; Atter & Davison, builders, Bruce Crescent (14) and Rennie & Son, builders, Regent Square, Hartlepool (12).

Hatfield.—Five shops and flats, Roe Green; Hatfield Development Corporation, Newtown House, St. Albans Road.

Hereford.—Houses (76), Tuppley estate; city surveyor.

Hinckley.—Bus station and car park, Rugby Road; and houses (34), Sketchley Hill estate; Council's architect.

Hoole.—Houses (30); U.D.C. surveyor.

Huddersfield.—County primary school, Bradley; borough architect.

Ilford.—Workshops and offices, for Elastica, Ltd., 29, High Road; A. J. Worthing & Co., builders, 48a, Ley Street, Ilford.

King's Lynn.—Hostel for aged persons; Norfolk architect, Stracey Road, Norwich.

Lanchester.—Houses (20), Burnhope; R.D.C. surveyor.

Leamington.—Factory and offices on trading estate; Kigass, Ltd., Kigass House, Regent Grove, Leamington Spa.

Leatherhead.—Old people's hostel; U.D.C. surveyor.

Leeds.—Erection of Parklands County Secondary School; W. J. Simms, Sons & Cooke, Ltd., Nottingham.

London.—Factory, offices, etc., in Victoria Road, W.3; Landis & Gyr, Ltd., Elgie Works, Victoria Road, W.3.

POPLAR.—Eleven shops and maisonettes; High Street, borough engineer.

WESTMINSTER.—Office building, Great Peter Street; Harry Neal, Ltd., 117, Baker Street, W.1.

Luton.—Fire station, Studley Road; county architect, Shire Hall, Bedford.

Maltby.—Factory extensions; D. Byford & Co., Ltd., hosiery manufacturers, Rotherham Road.

Manchester.—Health centre, Woodhouse Park, Wythenshawe (£44,745); city architect.

Middlesbrough.—Proposed Longlands County College (£180,000); Allen and Hill, quantity surveyors, Tankerville Terrace, Newcastle-on-Tyne.

Church, Woodlands Road, for St. Stephen's Church Council; P. Baines & Son, architects, 7, Brentnall Street, Middlesbrough.

Morpeth.—Houses (130); R.D.C. surveyor, Dacre Street.

Newcastle-on-Tyne.—Second stage of proposed bus depot, Slatyford Lane (£38,000); G. Bainbridge, builder, 205, Westgate Road.

Nottingham.—Scheme for extensive additions to Science Department (£1,200,000), to be spread over several years; University of Nottingham, University Park.

Peterlee (Co. Durham). — Houses (144), Acre Rigg, for Development Corporation; chief architect, Shotton Hall, Castle Eden.

Plymouth.—Factory additions, Cattedown; Fisons, Ltd., fertilizer manufacturers, Harvest House, Saltash Street.

Poole.—Workshop and offices; Hamworthy Engineering Co., Ltd., New Quay Road.

Portsmouth.—Flats (18), Leek Road, Wymering; A. E. Cogswell & Son, architects, Prudential Buildings, Commercial Road.

Skegness.—Secondary modern school, Burgh Road and Church Road; county architect, Lincoln.

Smethwick.—Factory extensions; H. Richards & Sons, Ltd., engineers, 10a, Albert Street.

Southend-on-Sea.—High school for girls (£224,000); borough architect, Municipal Buildings, Clarence Road.

Southport.—Mental deficiency colony, Greaves Hall, Banks, for the Liverpool Regional Hospital Board; Vincent Collinge, secretary to the Board, 19, James Street, Liverpool, 2.

South Shields.—Factory, Mill Dam; Elsy & Gibbons, Ltd., plumbing engineers.

Houses (100) for the T.C.; Myton, Ltd., contractors, Hull.

Torquay.—Factory; British Van Heusen, Ltd., shirt collar manufacturers, 8, Haymarket Street, London, S.W.1.

Tynemouth.—Factory additions, Norham Road, for Dukes & Markus, Ltd., and Congregational Church in Bolam Avenue; William Stockdale, architect, 73, Howard Street, North Shields.

Wakefield.—Houses (106) and flats (36), Kettlethorpe estate; Harlow & Milner, Ltd., Warren Yard, Warrengate, Wakefield.

Wallsend.—Houses (26), Sunholme estate; William Leech, Ltd., builders, 2, Clayton Street, Newcastle-on-Tyne.

Warrington.—Technical college, Long Lane; borough surveyor.

Housecraft Advisers' Conference

OVER 300 women electrical housecraft advisers and senior demonstrators from all parts of Great Britain and Northern Ireland are to attend the four-day conference organized by the Electrical Association for Women and the Electrical Development Association. Delegates will meet in the Royal Empire Society Hall, Craven Street, Charing Cross, London, on 26th and 27th January, at Olympia on 28th January, and in the Connaught Rooms, Great Queen Street, on 29th January.

Dame Caroline Haslett, chairman of the E.D.A. Council and director of the E.A.W., will preside at the Tuesday morning session, when the opening address will be given by Sir Henry Self, president of E.D.A. There will then be an address by Col. B. H. Leeson, director of the B.E.A.M.A., and in the afternoon Miss Marguerite Patten, the B.B.C. television cook, will speak on and give cooker demonstrations. Miss Joan Sharp, North Western Electricity Board, will give her Caroline Haslett Trust Lecture, "Western Germany To-day: Electricity for the Home," in the evening at the Institution of Electrical Engineers.

At Wednesday morning's session Miss Anne Smith, of Frigicold, Ltd., will deal with the question of freezing food for preservation and speak on the market for freezers, conservators and refrigerators. In the afternoon Mr. P. Honey (E.D.A.), will address the conference on water heating from the selling point of view. Miss Vera Norvick (E.A.W.) and Mr. J. A. Stedman (E.D.A.) will speak on prizes and awards in the electrical industry.

Thursday's proceedings will be held in the Addison Café, National Hall, Olympia, where the Hotel and Catering Exhibition is being held. In the morning Messrs. Felix A. Rogers and W. T. Gardiner (B.E.A.M.A.) will speak on the part that electricity can play in commercial catering, and in the afternoon the delegates will tour the exhibition. Friday's proceedings at the Connaught Rooms will take the form of discussion of the various papers and will conclude with the conference luncheon. In the afternoon the E.A.W. will be "at home" to delegates at the Association's headquarters, 35, Grosvenor Place, London, S.W.1.